Newman, (Sir) George
Some notes on medical education in England

BOARD OF EDUCATION.

SOME NOTES

ON

MEDICAL EDUCATION IN ENGLAND.

A Memorandum addressed to the President of the Board

BY

SIR GEORGE NEWMAN, K.C.B., M.D., F.R.C.P.,

Chief Medical Officer and a Principal Assistant Secretary of the Board of Education and Medical Assessor to the Universities Branch of the Board.

Presented to both Houses of Parliament by Command of His Majesty.

LONDON:
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1918.

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PREFATORY NOTE.

To the Right Hon. H. A. L. Fisher, M.P., LL.D.,
President of the Board of Education.

Sir,

(i) I have the honour to submit, in accordance with your request, a Memorandum of my work as Medical Assessor to the Universities Branch of the Board. Grants in aid of Medical Education were first made by the Board in 1908 under circumstances and conditions set out in the following report. From that date it has been my duty to advise the Board in regard to the assessment of such grants; and, in conjunction with the distinguished Medical Visitors specially appointed by the Board from time to time, I have visited periodically the Medical Schools in England and Wales, and have been able to discuss fully and frankly with the staffs difficulties and defects which they have themselves pointed out, or which have been observed by us, and the various ways in which the additional revenue provided by the Board could most appropriately be utilised to improve the work of the Schools. In 1912, I also had the advantage of visiting the principal Medical Schools in America, in Canada and in Germany. Almost unique opportunities have thus fallen to my lot of considering and comparing, over a period of some years, the various methods adopted in the Medical Schools in this country and elsewhere for the training of the medical student. Circumstances have in this way enabled me to obtain a general view both of the merits and of the limitations of our English system which it is hoped may be of interest, and, as the view of an independent though sympathetic critic, possibly even of value, to those concerned in Medical Education in this country. It would be presumptuous for any single individual to attempt to pass anything which might give the appearance of judgment upon the diverse and skilled work of the great body of able, competent and experienced teachers in the Medical Schools of England and Wales. My task in this Memorandum has rather been to set out briefly what seem to be the fundamental characteristics of a subject which is now of paramount national importance. If any comments or suggestions in this Memorandum appear on certain points to be unduly critical it should be remembered that there is hardly an instance where the defects to which your attention is drawn are not fully recognised and frankly admitted by those concerned, or where the improved methods which are suggested are not already in greater or less degree the practice of the most progressive schools or authorities; and that generally such defects as have manifested themselves are less attributable to the teaching staff than to the difficult circumstances and conditions under which the great enterprise of Medical Education has been carried on—and carried on in a way which reflects infinite credit on the teachers.

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(ii) Apart from the fact that some account was in any case overdue of the nature, aims and effects of the Board's grants to Medical Schools the present time, in spite of the pre-occupations of the War, seems to be not an inappropriate occasion for a general survey of our system of Medical Education. We have now had sufficient experience at the Board of the work of the Medical Schools to make it possible to avoid the immaturity of judgment which is due to insufficient or insecure data. We have also been able to observe the effect upon medical opinion in this country of the suggestive report of the Royal Commission on University Education in London, and the valuable Bulletin No. 6 of the "Carnegie Foundation for the Advancement of Teaching." Perhaps a still more important consideration is the increased significance which the question of Medical Education derives from recent scientific progress in such subjects as bacteriology and applied medicine and surgery, and from the rapidly growing claim of the State upon the active assistance of the medical profession. Great as this claim was before the War, it has become still more impressive now: for all the world is able to realise that, to repair the immense wastage of human life caused by the War, our primary need is an assured supply of medical practitioners trained to bring the resources of science, of research and of a liberal education to bear upon the prevention and cure of disease.

(iii) For reasons which will be obvious, my treatment of the questions under review must necessarily be of a brief, general and somewhat fragmentary character; and, though I am indebted to some of the highest medical authorities in Europe and America for counsel and advice, I do not conceal from myself the relatively tentative, provisional and incomplete nature of the observations which I am submitting for your consideration. To deal thoroughly with the work of all our Medical Schools and with the whole question of the training of students in the art and science of Medicine would require more leisure, knowledge and experience than are at my command. I have therefore confined myself to what appear to be the more immediately important features of the subject on which you have instructed me to report. Many of the large and pressing questions of medical polity which are closely associated with the narrower issue of educational method lie outside the scope of this Memorandum. Hence no attempt is made to touch upon questions of the organisation and governance of the profession, or, except incidentally, upon the examination system, which weighs all too heavily on the curriculum; similarly, there is no reference to such a burning question as the granting of degrees to medical students in London, or to the large issue of the just and reasonable claims of the profession concerning medical practice in its relation to the State.

(iv) The scope of the Memorandum is, I think, sufficiently defined in the contents table. It will be noticed that no specific reference is made to the medical education of women. The reason for this is that women students are now working side by side with men students on the same curriculum, and frequently in the same schools, laboratories and hospital wards. Hence there are insufficient grounds for differentiation in such a Memorandum as the present. I ought perhaps also to explain that the relative length of the section concerned with Preventive

Medicine denotes, not that it is, as a subject, larger or more important than other subjects of the curriculum, but that in my view it has hitherto received less consideration than the other subjects, though it is not less important in its claim upon the attention of the medical student as vital to the whole meaning and purpose of modern Medicine. In other words the unification of the curative and preventive aspects of Medicine seems to me to be one of the most pressing problems of both Medical Education and Medical Practice. The prevention of disease and its cure should be looked upon as integral parts of one and the same issue.

(v) I trust that the contents of this Memorandum will be accepted as they are offered, not as an *ex cathedra* pronouncement, but as a summary of data, and inferences drawn from data, which have come under my notice in my ordinary routine work as Medical Assessor to the Universities Branch of the Board. The defects or limitations recorded, and their proposed remedies, should be viewed in this light. Speaking broadly, the uncritical observer would probably be more impressed, and rightly so, with the magnitude and excellence of the work done in the Medical Schools than with its defects. But my submission is that careful examination and consideration of the working of the medical curriculum will be found to reveal, on the one hand, (*a*) a lack of University standard in much of the teaching; (*b*) insufficiently close co-ordination of the various constituent parts of the curriculum; (*c*) an absence of intimate association between the teaching of the clinical subjects and the work of research and investigation; and (*d*) inadequate facilities for advanced study: on the other hand it is manifest that the five or six years of the medical course are seriously overburdened with work, are too fully occupied to permit of healthy assimilation of much which the student is taught, and are too largely controlled by the examination system. The gravity of the present position is enhanced by the fact that upon a sound medical education depend some of the great reforms which the State awaits. Such public questions as the care of maternity, the declining birth rate, infant and child welfare, healthy adolescence, industrial hygiene, national physical efficiency and capacity, and the avoidance of disease and premature death, find their answer ultimately in the progress of the science of Medicine, in the extension of its healing art, and in the soundness and completeness of the equipment of its practitioners.

(vi) The removal, or at least the lessening, of the imperfections of the medical curriculum does not seem to present insuperable difficulties. A larger understanding of the new possibilities of medical science, appropriate guidance and direction in the further stages of the development of the English system of Medical Education, and increased financial aid, will in my judgment go far towards providing the repair and reconstruction which is necessary.

(vii) Several of the following Sections are introduced with a summary mention of the outstanding features in the historical evolution of the subjects with which they are concerned. It is hardly necessary to explain that these historical notes are merely intended as a remembrance and illustration of the course of past events, which may enable us to view the problems of the present in their true perspective and help us to forecast the direction of

future progress. For it has been no uncommon experience in the past that discussions of Medical Education have been not a little prejudiced from being considered too much from the point of view of professional politics or current controversy and too little in their relation to the large outlines of movement and progress in an ancient art and science. The history of the advance of Medicine, the growth over long centuries of its dignity and learning and of its spirit and service, is full of significance and guidance for the future. Its foundation in scientific method and its office of service and duty to the community are both its vindication and its inspiration.

(viii) It is a great pleasure to acknowledge the consideration, courtesy and co-operation of the members and officers of the respective Medical Faculties in regard to the assessment of the Medical grants.

I have the honour to be,
Sir,
Your obedient Servant,
GEORGE NEWMAN.

Whitehall, June, 1918.

SECTION I.

INTRODUCTION.

1. Before proceeding to consider the nature and necessities of Medical Education it is desirable to review briefly the history and purpose of the grants of the Board of Education in aid of medical education and the machinery by which they are assessed. The responsible bodies concerned with the education of the medical practitioner are the Medical Schools as training institutions, the Licensing Bodies as examining boards, the General Medical Council for purposes of general supervision, and the Board of Education which provides grants in aid.

2. Every medical student must take a course of training at a recognised *Medical School*, covering at least a period of five years and normally extending to six years or more. There are 22 Medical Schools in England and Wales, of which 12 are situated in London. All the Schools are more or less closely associated with a University; but whereas in London the ultimate authority of the Medical School is generally the hospital to which it is attached, outside London it is generally the University. Not all recognised Schools provide for instruction in the full medical course (Preliminary, Intermediate, Final or Clinical subjects); some provide for Clinical studies only; others for Intermediate and Clinical; others again for Preliminary and Intermediate only. *The Licensing Bodies* are of two kinds. First, there are those which admit to their examinations students from any recognised medical school who satisfy certain prescribed conditions; the most important of these are the Conjoint Board of the Royal Colleges of Physicians and Surgeons in London and the University of London. Secondly, there are the Universities, whose principal aim is education, which admit to their examinations only the students for whose training they are themselves responsible.

3. *The General Council of Medical Education and Registration of the United Kingdom* (commonly called The General Medical Council) consists of representatives of the various Licensing Bodies, together with five members appointed by the Crown on the advice of the Privy Council and six elected as direct representatives of the Medical Profession. The Council, which is responsible to the Lord President of the Privy Council, was established by the Medical Act of 1858 in order to ensure an efficient medical service for the public. The principal duties of the Council are: —

(*a*) To keep the Register, inclusion in which is, in effect, a condition precedent to practising Medicine and Surgery in the United Kingdom. The Registrar must enter upon this Register all persons who present their names for the purpose if they possess the requisite qualifications.

(*b*) Under Section 20 of the Medical Act of 1858 it is the duty of the Council to consider in the case of "the course of study "and examinations to be gone through in order to obtain "the Diploma of Doctor, Licentiate, &c., whether they are

" such as to secure the possession of the requisite knowledge " and skill for the efficient practice of the Profession of " Medicine." Under Section 19 of the Medical Act of 1886 the Council is charged with the duty of securing "the maintenance of a sufficient standard of proficiency" at the qualifying examinations prescribed by the Medical Acts of 1866 and 1886. Section 18 of the Medical Act of 1858 gave the Council power to require that every Body granting a Diploma should furnish the Council with such information as it may demand as to the courses of study and examinations for their respective qualifications, and any member or members of the Council, or persons deputed for the purpose, may attend any such examination. Under the Act of 1886 the Council is specifically authorised to employ and pay Inspectors, and the duties of the Inspectors are defined by statute and limited to inspection and report. The Acts do not confer on the Council the power of prescribing the conditions of the curriculum beyond the general power of requiring to be satisfied as to the sufficiency of the course of education and examination. The reports of the Inspectors and the comments of the Examination Committee of the Council are furnished to the Bodies concerned and receive the consideration to which they are entitled, but the Council has no power to enforce its views except by the extreme method of a report to the Privy Council (which may withhold the privilege of registration).

(*c*) The Council possesses certain penal and disciplinary duties with regard to the misconduct of persons whose names are on the Register.

(*d*) The codification of pharmaceutical remedies is also a duty of the Council.

(*e*) Though it is not a statutory requirement, the Council compiles a list of medical students who have passed the requisite preliminary examination in general education and have commenced professional study; and it is customary for most of the Licensing Bodies to insist on the registration of their students by the Council.

4. *The Board of Education* are concerned with medical education as being the Government Department charged by Parliament with "the superintendence of matters relating to education in England and Wales." In the performance of its statutory duty in regard to the superintendence of all forms of education in England and Wales the Board necessarily acquire a wide knowledge and experience of other forms and branches of education which are of value in considering the special problems of medical education. The Board are not concerned with the licensing of the medical practitioner to practise, and their interest in the qualifying examination lies in the suitability of such examination as a test of the education and training of a student, and in the prejudicial influence which may be exerted by unsuitable tests upon the character of the education afforded. Finally, the Board possess and exercise the power of giving grants in aid of medical education in England.

Recognition of Medical Schools for Grant in Aid.

5. The three principal causes which have led the Medical Schools in England to apply for grants in aid from the Board are briefly: the restriction of the scope of the grants-in-aid originally made by the Treasury to "Universities and University Colleges" in England to general subjects, and the consequent exclusion from their purview of professional and technological education; the increased cost of the medical training and in particular of the preliminary instruction in Science; and the decision of the King Edward VII.'s Hospital Fund to withhold contributions from those hospitals in London which use any part of the subscriptions or funds of the Hospital for the benefit of their Medical Schools. These conditions, associated in London with the decline in the number of medical students, led to application for *ad hoc* grants for medical education.

6. In March 1908, an application from St. Mary's Medical School was received, and after due consideration the School was recognised as eligible for grants under the Board's Regulations for Technical Schools, &c. The granting of this application was quickly followed by applications for the recognition of other Medical Schools both in London and the Provinces. The only Medical Schools in England not now in receipt of grant from the Board are those attached to Guy's and Middlesex Hospitals, and the Universities of Oxford and Bristol. Special provision for the Medical Department of the University of Cardiff is included in the annual maintenance grant which the Treasury pay to that college.

7. Before recognising a Medical School as eligible for grant the Board have in the first place had to be satisfied as to the nature of the arrangements for the government and management of the School, and as to the security for the permanence of its work; in the second place they have had to decide what portions of the course could properly be taken into account for the purposes of grant. As regards the first group of considerations, the following quotation from a letter addressed in 1908 to the first successful applicant for recognition sets out the general principles upon which the Board have proceeded:—

> (*a*) Generally speaking, the Board look to securing that any Institution aided by these Grants is an Institution of a permanent character, as distinguished from such an ephemeral entity as a congeries of classes. By this it is not meant that any legal or other security should be given for the continuation in perpetuity of the work of the Institution, but that there should be a reasonable anticipation that work built up with the assistance of Grants from the State should not cease capriciously, and the educational goodwill, so to speak, thus created be dissipated. The Board would therefore look in the first place for an understanding on the part of those responsible for the conduct of the Institution aided that this condition would be fulfilled.
>
> (*b*) Looked at from another point of view, the Board would also consider that when they commence to pay Grant in any particular year to an Institution offering a course of study necessarily extending over several years, it would be necessary for them, in the interests of the students, to be assured, by whatever reasonable means are open to the authorities of the Institution, that any student on entering upon his course would have adequate provision made for its completion.
>
> (*c*) It is further a principle governing the action of the Board in paying Grants to any Institution which is not actually provided and maintained by a Local Education Authority that the whole sum paid by the Board should be devoted to the furtherance of the education given at the Institution,

and that no portion of the Board's Grant should be diverted to any other purposes, even though such other purposes might be those of any other Institution of which the Institution in receipt of Grants may form part or with which it may be connected.

With regard to the principle implied in the phrase in Article 9 of the Regulations that Grants are not payable to Institutions conducted for private profit, this expression must be construed in its fullest and widest sense as excluding the possibility of any person employed in or connected with the Institution receiving from it any payment except in respect of services rendered to the Institution by him. In order to carry out this corollary of the main principle, the Board exact as a general rule that persons so employed should be employed at a defined salary. As a further corollary, the Board's Grants must be so applied as to meet only the maintenance expenses of the Institution, and not, for example, be expended in the payment off of capital charges, in the accumulation of funds to meet future capital charges, or in actual expenditure in the year in which they are received upon any purpose which could fairly be looked upon as one for which provision should be made out of capital.

(*d*) Applying these principles generally to the case of a Medical School it will be realised at once that the connection which generally obtains between a Medical School and a Hospital is of such a nature that special care must be taken to see that no infringement of the principle laid down in paragraph (*c*) above occurs. The Board understand that as matters now are the accounts of the Hospital and the Medical School are for other purposes kept distinct, but they are not prepared, on the information at present before them, to accept this as necessarily giving all the security that they may require.

(*e*) In the same way, having regard to the fact that the payment of the clinical staff of a Medical School is, under modern conditions, largely hypothetical, the Board would require that the payment should be placed upon some defined basis. They would not indeed require that the clinical staff should be in receipt of salaries which were equal, taking one year with another, or indeed that they should be paid anything at all if the funds of the Hospital were unable to bear such a burden, but they would require the establishment of such a scheme of payment as would determine beforehand the method under which any payment to the staff should be calculated.

8. The application to different Schools of the policy thus defined has largely depended upon their individual circumstances and has always been determined in full consultation with the authorities of the Institution. In London, largely from causes which could be traced to the nature of their origin, many of the Medical Schools possessed no ascertainable legal status, and were, in fact, only voluntary associations of teachers. With a view to securing a proper system of government and management, and also a reasonable degree of permanence, the Board sought to secure, first, that the Governing Body of the Hospital should be established as the ultimate authority of the Medical School; and secondly that suitable provision should be made for the actual management and conduct of the School. Enquiry revealed the fact that at some London Schools it had been the practice to credit the whole of the composition fees of students to the year in which they were received, although such fees obviously had reference to future years. This was clearly an unsound system of finance which must endanger the stability of the schools concerned. In some cases a serious deficit was found to exist, and here it was made a condition that the Authorities of the School should make definite arrangements for wiping off the deficit.

9. Preliminary questions also called for settlement in connection with the recognition of provincial Medical Schools, for while the University was the Body responsible to the students for the provision

of a suitable course of instruction, there was in most cases nothing to prevent the various Infirmaries and Hospitals which provided clinical facilities from closing their doors at any moment to University students. To meet this difficulty it was arranged that resolutions should be passed by the Infirmaries and Hospitals concerned, providing that existing arrangements should not be terminated without such notice as would enable all the students then in attendance to complete the course before the clinical facilities were withdrawn. A second difficulty, closely allied to the first, arose from the fact that, as a rule, Infirmaries and Hospitals were in no way under the direct control of the Universities, and the latter were able to exercise little direct influence or financial control over the clinical instruction of their students. They had no voice in the appointment of clinical teachers or control of the payments made to them. The necessary adjustment was not free from difficulty, but it was generally found possible to provide for future appointments of clinical teachers to be made by mutual agreement.

The following table shows the year in respect of which grant was first paid by the Board of Education in aid of medical education to various Universities and Schools in England, and also, in respect of the year 1913–14, the number of students on which the calculation of grant under the "Statement" was based:—

Year in which recognised.	Name of Medical School or Department.	Number of Students, 1913–14.	
		Whole-Time.	Part-Time.
1908– 9	St. Mary's Hospital Medical School	91	53
1909–10	Durham College of Medicine	165	31
1909–10	Leeds University Medical Department	132	30
1909–10	Liverpool University Medical Department	183	128
1909–10	Manchester University Medical Department	108	117
1909–10	Charing Cross Hospital Medical School	40	49
1909–10	London Hospital Medical College	256	124
1909–10	London (Royal Free Hospital) School of Medicine for Women.	119	25
1909–10	St. George's Hospital Medical School	36	17
1909–10	St. Thomas's Hospital Medical School	224	14
1909–10	University College, London, Medical School	248	178
1909–10	Westminster Hospital Medical School	11	20
1910–11	Birmingham University Medical Department	149	1
1910–11	Sheffield University Medical Department	46	42
1910–11	King's College, London, Medical School	104	164
1911–12	London School of Tropical Medicine	—	145
1913–14	Cambridge University Medical Department	382	26
1913–14	St. Bartholomew's Hospital Medical School	202	126

The Universities of Oxford and Bristol, and Guy's Hospital and the Middlesex Hospital Schools have not applied for or received grant under the Statement.

Conditions of Grants in Aid.

10. While the Board have power in principle to take into account for grant all the three parts (preliminary, intermediate, final) of the Medical Course, they have not for various reasons always done so. In

London one of the most difficult problems of medical education has been the proper organisation of the preliminary medical studies, and Statute 80 of the Statutes made by the Commissioners appointed under the University of London Act, 1898, provides that—

> "with a view to greater efficiency and economy the Senate . . . shall use its best endeavours whenever practicable to secure . . . common courses of instruction for internal medical students in the preliminary and intermediate portion of their studies under Appointed or Recognised Teachers at one or more centres."

Though one or two Schools have voluntarily arranged for their students to receive instruction in preliminary and intermediate subjects at other Institutions, the University for various reasons have not found it practicable to give effect to this Statute. The Board were strongly of opinion that they should do nothing which might further embarrass the carrying out of the Statute, and they accordingly informed the Schools that applied for grant that—

> "In view of the statutory obligation laid upon the University of London to concentrate the teaching of preliminary medical studies by the statutes made under the University of London Act, 1898, the Board will not for the present be prepared to recognise such instruction given at the Hospital as falls under the heading of what may be described as 'preliminary medical studies,' that is to say, as regards the year now closing no attendances will be included for the purpose of calculating grant which were made by students in the first year of the course shown on the time-table on Form 130a T. under the heading of Preliminary Scientific; and this limitation will prevail also in respect of the ensuing year."

The Board did not, however, feel the same difficulty in the way of paying grants in respect of intermediate medical studies, but in view of the appointment of the Royal Commission on University Education in London, they reserved to themselves the right to reconsider the whole question in the light of any report which might be made by the Commission, or in connection with any movement that might be initiated towards the concentration of instruction in those subjects of study.

In the Provinces the question of recognising for grant the whole course of study took a different form. In nearly all cases a part, at any rate, of the preliminary medical studies is taken as part of the general instruction in science provided by the Faculty of Science. Since such instruction fell within the purview of the Treasury grants for Universities and University Colleges, it could not also be taken account of for the Board's grants. Further, the Board did not consider themselves justified in paying grant on the clinical studies of the students until a readjustment of the relations between the Universities and the Hospitals had secured to the Universities a satisfactory measure of responsibility for the conduct of those studies.

11. In the Prefatory Memorandum to the Technical School Regulations* of 1910 it was stated that the Board were "conscious that the "Regulations, which have come into existence by a process of gradual "development from the Directory of the former Department of Science "and Art, are not as a whole well adapted to the conditions under "which the instruction which they are designed to aid is now given." "In particular," the note proceeded, "it will be necessary to provide "simpler and more suitable means of allocating the grants payable

* Regulations for Technical Schools, Schools of Art, and other Forms of Provision of Further Education in England and Wales.

" under the Regulations of the Board of Education to institutions of " University rank, and for co-ordinating these grants with those paid " to the same institutions by the Treasury; separate Regulations will " accordingly be arranged for this purpose. The Board must, of " course, be satisfied that the courses provided are adequate in range " and length, and that the students are regular in their attendance, " but it is hoped that these requirements can be secured without " interfering with the freedom of Universities to work out their curricula " in the ways best suited to their individual needs."

In 1911, the Board (to whom the administration of the Exchequer Grants to Universities and Colleges had earlier in the year been transferred by the Treasury) issued for the first time the set of provisions entitled a "Statement of Grants available from the Board " of Education in aid of Technological and Professional Work in " Universities in England and Wales," generally for the sake of brevity referred to simply as the "Statement." The provisions of the Statement contained various important changes in the methods of calculating and paying the grants.

(*a*) Under the Regulations for Technical Schools the grant had been based on the number of hours of instruction received by the student during the academical year. This basis was not suited to University conditions of work, and therefore under the Statement grant was based on the number of students who, during the academical year under review, were certified by the Vice-Chancellor or other approved Officer on a simple Form as having satisfactorily completed a year's work in a full-time (or part-time) course of instruction.

(*b*) The student-hour basis of grant had involved a system of registration which was liable to be irksome in character and was otherwise unsuited to the conditions of the course. The change referred to in the last paragraph enabled the arrangements for registration to be materially simplified.

(*c*) Under the Statement the grant is calculated at a different rate for full-time students and for part-time students. Moreover when once a rate has been fixed it is not altered unless the Board are satisfied that a more or less permanent change has taken place in the character and scope of the work of the Institution.

(*d*) Under the Regulations for Technical Schools the grant was paid at an uncertain date in the financial year and the amount of it could not be accurately anticipated. In order to help the Schools in drawing up their annual budgets it was provided that for the future the amount of grant for the financial year should be announced before the commencement of the year and should be paid in three equal terminal instalments. It is based on the work done during the last completed academical year. Thus the grant payable for the financial year which began on April 1st, 1915, was announced about March 1915, and was paid in three equal instalments in April 1915, October 1915 and January 1916. The grant was based on the work done during the academical year which ended in the summer of 1914 and for which the returns were sent in by the Schools towards the close of that year.

It should be added that in order to meet the special difficulties that have arisen out of the War the Board have, for the present, power to pay an annual grant of the same amount as that paid in the financial year, which began on April 1st, 1915, and was based on the student figures of the last pre-war academical year, subject to such increase or decrease as may appear to them to be justified by any change in the character, efficiency, volume and cost of the work of the Institution.

The Principles on which Grants are made.

12. In considering an application from any University Institution for the recognition of its courses under the Statement the Board have regard, under paragraph 2 of the Statement, to "(i) the extent to which "both the staff and advanced students of the University Institution are "active in advancing knowledge; (ii) the existing supply of educational "facilities similar to those given in the University Institution; (iii) the "relation of the University Institution to Secondary and Continuation "Schools; (iv) the allocation of all Parliamentary Grants of whatever "kind to the University Institution; and (v) the various circumstances "and characteristics which should differentiate the work and functions "of the University Institution from those of other Institutions not of "University rank. When once given grants will be continued ordinarily "from year to year, but the Board will take the above-mentioned matters "into consideration annually, and also the reports furnished to them "by the University Institution."

13. The considerations to be taken into account in determining the grant payable to the Institution are thus described in paragraph 9 of the Statement.

> "In making the grants the Board will necessarily be guided by a number of considerations, some of which will have a general bearing upon their decision when application is first made to them for aid, or when they are making their annual survey of the work of an institution with a view to continuing their grants. Other considerations will have a direct effect upon the amount of grant paid in respect of each student who has taken a full-time or part-time course of instruction. Among the considerations referred to above as having a general bearing, the Board consider it as most important that the authorities of a University Institution should make such arrangements regulating the admission of students to courses as to exclude those who, for want of sufficient previous education (whether general or special) or from inexperience or other cause, are not qualified to take advantage of the instruction. Under these arrangements it is anticipated that no student will be admitted to a full-time diploma or degree course unless he is over 17 on the day preceding the beginning of the academical year and has passed a Matriculation or other examination qualifying him to undertake work of a University standard. The Board also regard it as important that a University Institution (subject to its discretionary power in dealing with exceptional cases) should require a student who applies for admission to a full-time diploma or degree course, to have been in attendance at a Secondary School for at least four years subsequent to the age of 12, or to have been at least two years in regular employment and in attendance at organised Evening or Day Courses. It is also important that the system of registering the attendance of students should be suitable and carried out in such a way as to furnish adequate basis for any returns which may be made from time to time in support of claims for grant or for other purposes."
>
> "Finally, it is most important to bear in mind the standing and efficiency of the teaching staff. In considering whether they will recognise courses for the first time or continue to aid courses already recognised, or whether they should alter the amount of aid payable in respect of such courses, the Board"

> " will necessarily have regard to the extent to which the teaching staff encourage the advanced students to prosecute research and the extent to which the teachers avoid undertaking duties likely to interfere with the efficient discharge of their work in connection with the courses aided by these grants. In particular, regard will be had to the number of students who are taking diploma, degree, or post-graduate courses respectively in calculating the rate of grant."

14. Finally, it may be said that in determining questions relating to grants in aid, and indeed in all their relations with University Institutions, the Board proceed on certain general principles. First, they recognise that a wide measure of freedom is fundamental to the proper development of true University work. Whilst therefore the Board take every opportunity of consulting with the Authorities of a School on points of difficulty, and are willing to give any advice which their experience suggests concerning promising lines of development, they make no attempt to prescribe the adoption of any " model course " or particular method of teaching. Secondly, in judging the work of a School, though they necessarily draw upon the knowledge and experience which they have acquired of the best practice at home and abroad, their judgment is of the character and standard of the work done, considered on its own intrinsic merits. Thirdly, while the Board are naturally concerned to know how their grant is used, and while they are anxious that the School Authorities should discuss this and other matters frankly with the persons whom the Board send to visit and report upon the work, they have always refrained from prescribing any particular method of allocating the additional revenue which their grant provides.

15. For a proper discharge of their functions the Board cannot afford to rely solely on Reports and Returns. It is necessary that they should also possess first-hand knowledge of the character and scope of the work being done in different Institutions, and also in regard to the views of the Universities in regard to questions of common concern. Accordingly, to meet these needs, they appointed in 1911 a special Standing Committee to advise them in regard to various problems of University Education in England and Wales. Further, after consultation with this Committee they have selected persons of pre-eminence in their profession to visit University Institutions, and to report upon the nature and character of the medical work accomplished. In accordance with this policy Sir Thomas Barlow, Bart., K.C.V.O., F.R.S. (late President of the Royal College of Physicians) and Sir Clifford Allbutt, K.C.B., F.R.S. (Regius Professor of Physic at Cambridge) have, during the last few years, visited on behalf of the Board the Medical Schools in London and the Provinces.

16. In order to understand the scope and necessity of grants in aid it is necessary to consider the present position and needs of medical education in England, the character of a University Education in Medicine, and the content of the medical curriculum. These matters are dealt with in the succeeding sections of this Memorandum.

SECTION II.

THE FUNCTION OF THE MEDICAL PRACTITIONER.

17. The Charter of the Barber Surgeons was granted by Edward VI. in 1461, the first medical registration Act was passed in 1511, and the Royal College of Physicians was founded by Henry VIII. in 1518. These are the three events which mark off the Middle Ages from the Modern Period in respect of the relation of the State to the profession of Medicine. From these dates we measure the recognition of an organised profession and an ever-increasing relation, an ever-growing community of interest, between the State and the doctor. The apothecary, the surgeon and the physician had their several spheres of influence—the apothecary dealt like a grocer in worts, drugs and "herbals," an early form of pharmacopœia which flourished and multiplied in the sixteenth century; the surgeon was a variety of barber skilled in bleeding, bandaging and bone-setting; the physician belonged to the learned world of his day, half doctor, half ecclesiastic, and wholly devoted to ancient tradition. But from this time onwards the medical man had a professional position in the State. There had been for 200 years previously an intermittent and uncertain development of sanitary measures, royal proclamations and commissions in behalf of land reclamation, street cleansing, removal of garbage, isolation of lepers, and the care of vagrants and mendicants, which found its culmination in the great Poor Law of Elizabeth in 1601. But the increase of population and the occurrence of severe epidemics of disease led to conditions more seriously demanding medical attention. Pestilence has ever been the opportunity of Medicine, and the early part and middle of the seventeenth century witnessed a widespread degree of insanitation and numerous invasions of the plague. The Tudor practitioner had never been faced with problems of such magnitude. He had rarely been called to depart from the strait and narrow way of individual and empirical practice, or to meet a situation in which the traditions of Galen proved insufficient or unequal. In the dilemma of this scourge, the College of Physicians met and conferred upon means for preventing infection; houses were marked by a sign and guarded; and a primitive form of quarantine was introduced. But all this was to little purpose, and in 1665 it was estimated that 100,000 persons died of the plague in six months in London alone. The following year witnessed the drastic sanitation of the Great Fire, and in the last quarter of the century a new London grew up, and men's thoughts turned hopefully to an improved social life.

18. Meanwhile the science and art of Medicine had during the seventeenth century made substantial progress and, as we shall see subsequently, Sydenham and his fellow practitioners, and the pioneer physiologists, pathologists and workers in preventive medicine, had profoundly altered the whole outlook. This growth of medical knowledge happened concurrently with an advance in social life and aspiration, a development in private practice and recurring visitations of epidemic disease, three factors which together taught the State to

recognise its debt to, and claim upon, the medical profession.* We had, therefore, this two-fold change, an increase in knowledge and the occasion for its application. From this time also, medical evidence was frequently required by the State, and the early official reports of the nineteenth century on child labour, on proposed factory legislation, on the poor laws and on the sanitary condition and health of the people are full to overflowing of expert evidence from the profession. In 1836 came the imposition of the duty of the medical practitioner to notify births and deaths, in 1840 the Vaccination Acts began, in 1848 came the appointment of local medical officers of health, in 1858 was passed the Medical Act which established the General Medical Council, and soon thereafter a whole series of Public Health measures extended the claim of the State on the medical practitioner.

It is approximately 350 years from the complete individualism and empiricism of Medicine under the Tudors to the present position of the doctor in the State. But during that period a vaster revolution in medical thought and practice had taken place than in the fifty generations between that time and the age of Galen; nor can it be doubted that the period since Darwin's *Origin of Species* and the Medical Act of 1858 has more profoundly modified the scope and sphere of the profession of Medicine than all the long centuries from Hippocrates.

19. The medical practitioner of the early days of the nineteenth century or even of the Victorian period seems to us now almost as remote as a Tudor physician. We have a glimpse of the doctor of the period in a well-known description by Thackeray:—

> "Early in the regency of George the Magnificent, there lived in a small town in the West of England, called Clavering, a gentleman whose name was Pendennis. There were those alive who remembered having seen his name painted on a board, which was surmounted by a gilt pestle and mortar over the door of a very humble little shop in the city of Bath, where Mr. Pendennis exercised the profession of apothecary and surgeon; and where he not only attended gentlemen in their sick-rooms, and ladies at the most interesting periods of their lives, but would condescend to sell a brown-paper plaster to a farmer's wife across the counter—or to vend tooth-brushes, hair-powder and London perfumery. . . . The good company of Bath patronized him, and amongst the ladies especially he was beloved and admired. First, his humble little shop became a smart one; then he discarded the selling of tooth-brushes and perfumery, as unworthy of a gentleman of ancient lineage; then he shut up the shop altogether, and only had a little surgery attended by a genteel young man; then he had a gig with a man to drive him; and, before his exit from this world, his poor old mother had the happiness of seeing from her bedroom window, her beloved John step into a close carriage

* One of the first occasions in which Parliament itself called for medical advice arose out of its consideration of the reports which John Howard, the Member for Bedford, gave to the House of Commons in 1774 on his "winter journey" to the prisons. Dr. John Fothergill and Mr. Percival Pott were called in.

> of his own, a one-horse carriage it is true, but with the arms of the family of Pendennis handsomely emblazoned on the panels."*

Within the life-time of men now living the old-fashioned type of pre-Listerian family doctor flourished in every part of the country. He grew out of the apprenticeship system, and lived and laboured in the sphere of individual responsibility, the confidant and counsellor of his patients, unconcerned with public duties and subject generally speaking to no statutory requirements.

The Changing Conditions of Practice.

20. Now all that is changed. The claims of private practice have grown socially more insistent and medically more exacting. The methods both of diagnosis and treatment are more onerous than at any former stage in the history of Medicine. Nor can the general practitioner any longer escape definite relationship with the existing system of medical responsibility or fail to answer to the call to a wider sphere. For in whatever direction we look we find an ever increasing burden of professional duty imposed upon him with an ever increasing responsibility to the State—both duty and responsibility making necessary an improved and more complete training and education.

The growth of Medicine and its differentiation has been out of all proportion greater than the growth of medical education. The education has failed to keep pace with the science. The practitioner has lost ground in the medical specialities—the eye, ear, nose and throat, the skin, mental diseases and fevers—and now he is in danger of being excluded from the treatment of tuberculosis, of venereal disease, and of maternity. But the general practitioners are, it has been well said, the vertebrae of the backbone of the profession, and if they are not equal to their expanding science, it indicates defects in their education.

In recent years, also, Parliament has imposed statutory duties upon the medical practitioner of which the public hear little or nothing. Apart from the fact that he may be called upon to undertake official duties in the public service he is liable under statute in the following respects:—

(1) He must certify births and deaths (Births and Deaths Registration Act, 1874) and notify all births within 36 hours (Notification of Births Acts, 1907–15); he must notify cases of infectious disease (Infectious Diseases Notification Acts, 1889 and 1899, and special Notification Regulations as issued), of industrial poisoning (Factory and Workshop Act, 1901), and of verminous children (Children Act, 1908). He must also be ready to vaccinate (Vaccination Acts, 1871–1907); and to certify the removal of infectious cases to hospital (Public Health Act, 1875).

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* Thackeray's *Pendennis*, chap. ii. Dickens gave us in *Pickwick Papers* (1837) a graphic picture of Bob Sawyer and Ben Allen, and in *Martin Chuzzlewit* (1843) Mr. John Jobling, M.R.C.S.; Mrs. Gaskell depicted several doctors (1851–64); Chas. Kingsley in *Two Years Ago* (1857) gave us Thurnell; Trollope's *Dr. Thorne* appeared in 1858; and George Eliot in *Middlemarch* (1871) described the life and labour of Mr. Lydgate.

(2) He may be called upon to inspect and certify for house disinfection (Public Health Act, 1875, and Infectious Disease Prevention Act, 1890), and be prepared to issue certificates for the removal and burial of dead bodies (*Ibid.*).

(3) He may be required to inspect and condemn in regard to nuisances and insanitary house property (Public Health Act, 1875, or Amendment Act, 1907); or inquire into unhealthy or insanitary areas (Housing of the Working Classes Act, 1890).

(4) He must know something of the ill-effect upon health of dangerous or offensive trades (Public Health Act, 1875); and of unsound food (Public Health (Unsound Food) Regulations, 1908).

(5) He must be competent to diagnose all forms of mental disease (Mental Deficiency Act, 1913).

(6) He must be available to respond to the requirements of the local sanitary authority for the provision of medical assistance and treatment for the poorer inhabitants of the district in which he lives (Public Health Act, 1875, s. 133).

(7) Lastly, the medical practitioner is now liable for a new series of duties in regard to workmen's compensation (Workmen's Compensation Act, 1906, s. 8.) superannuation and pension claims.

It is obvious that whilst some of these obligations are incidental to medical practice, the effective discharge of others constitutes something in the nature of a new kind of demand on the knowledge and experience of the medical man.

21. Again, under the National Insurance Act (1911) 14 million persons in England are eligible for medical benefit, upwards of 15,000 doctors are under agreement as panel medical officers, 10,000 chemists supply medicine, and the number of prescriptions issued exceeds 25 millions per annum. This new duty also raises new issues, as will be seen in the following words:—

> "Doctors have in the past been by training and by the conditions under which they practise their profession, an individualistic class. Their work is performed in the main in the privacy of the consulting room, and for the manner in which they discharge their duties they have to a large extent been responsible only to their patient and to their conscience. But new conditions of a far reaching character have been called into being by the passing of the Insurance Act. The profession has now become one of the essential elements in working the Act, and is called upon to play its part in a great national scheme. It is evident, however, that in many cases this wider responsibility has not yet been realized."*

Alongside this vast scheme of State medical treatment there is a rapidly expanding clinic and hospital service, both general and special, in which practitioners are frequently called upon to furnish the professional staff.

22. Still more significant is the further development of the public medical services. Previous to the introduction of the great

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* Report of Departmental Committee on Sickness Benefit Claims under the National Insurance Act, 1914 (Cd. 7687), p. 36.

sanitary measures of the last half of the nineteenth century medical practitioners were called in to advise the State intermittently,* and served habitually under the Poor Law Commission of 1834. But after the passing of the Public Health Acts, and particularly the Acts of 1872 and 1875, the doctor came to occupy a new position as public official in the form of medical officer of health. The first appointments were made by two great municipalities, Liverpool and the City of London, in 1847 and 1848, but in 1872 the country was subdivided into several hundred sanitary areas for which medical officers of health were made responsible. There followed a series of enactments which brought in their train successive officers for specific purposes, and at present (1918) we have the somewhat remarkable result that the State either directly or through the municipality is employing, whole-time or part-time, a very large number of medical men in the Public Health Services:—

I. As Poor Law Officers—	
(*a*) in Establishments	1,080
(*b*) as District Medical Officers	3,761
II. In the Sanitary Service—	
(*a*) Medical Officers of Health (Whole-time public officers, 285.)	1,600
(*a*) Tuberculosis Officers	238
III. In the School Medical Service	1,300
IV. As Certifying Factory Surgeons	1,300
V. As General Post Office Medical Officers	3,360
VI. In the Army, Navy and Colonial Services (1913)	3,000
VII. Under the Scheme of National Health Insurance for England and Wales (Panel doctors)	16,392
VIII. Under the Lunacy Acts and the Board of Control for the Feeble-Minded	324

It will, of course, be understood that in many instances the medical men engaged in public duties are filling more than one of the appointments named above, which means that these figures are not mutually exclusive, and thus many practitioners are called upon to fulfil very diverse duties in addition to private practice.

23. Now this imposition of duties and functions by the State on the private and public practitioner of Medicine involves, it is obvious, a new and wider sphere of action than anything which has been characteristic of medical practice in the past. It does not, however, involve the relegation of the general practitioner to the background. His place in the community is not less, but more important. His individualistic character and devotion in practice, his relation to the personal and family life of his patient, his social relationship, his opportunity of studying disease both at its initiation and in its progress are all invaluable traits of the profession. We are not here concerned with their disturbance in any way. My point is that it is abundantly clear that though hitherto the patient concerned has been interested in the capacity and skill of his doctor, now in addition to the individual patient the State itself is deeply involved in the

* Poor Law Commission, 1842; Commission on Health of Towns, 1844–45; Royal Sanitary Commission, 1869, &c.

education of the doctor. For *if he be not adequately trained* the vast national scheme of medical poor relief, of health insurance, of the medical care of the army, navy, air and colonial services, and of the public health civil services cannot be sustained. But there is another reason beyond this why the State is now more concerned in the education of the doctor than formerly. It is that the layman, the ordinary citizen, is increasingly involved in public responsibilities which he cannot safely or effectually discharge without competent medical guidance. The layman now takes the governing position on hospital boards, on local sanitary committees, on education committees, and on insurance committees. Thus Medicine has become a quasi-public profession, in the character and equipment of which the State is deeply concerned; and the citizen himself, as legislator and as tax-payer no less than as patient, is interested in the maintenance of a high standard of medical education. It has been well said that "the level of medical practice "depends in a very large measure upon the intelligence of the average "citizen with respect to professional training." The problem has become, in short, an educational problem of national concern, and every citizen is a gainer by the growth of efficient medical education, and in particular by the death of every form of medical charlatanism, quackery, incompetence or inefficiency.

That is the case for reform of medical education—first, the growth of medicine and its differentiation; second, the increase of statutory obligation to which the practitioner is liable; third, the extension of private medical practice; fourth, the introduction of new public medical services; fifth, the needs of the State.

The Requirement in Medical Education.

24. At the formal opening of the Johns Hopkins University at Baltimore in 1876 Professor Huxley discussed the objects of medical education. He declared that the medical practitioner must be able on the one hand to prevent disease by his knowledge of hygiene, and on the other to divine its nature and to alleviate or cure it. In order to achieve these great ends the practitioner must first understand *health*, he must have "a thorough and practical knowledge of the conditions "of health, of the causes which tend to the establishment of disease, "of the meaning of symptoms, and of the uses of medicines and "operative appliances"; and next he must understand the *nature of disease*, the structure of the human body and its manifold actions implying a knowledge of anatomy, physiology, chemistry and therapeutics.*

I have chosen Professor Huxley's words because they set in the forefront the primary condition of physiological health. The type of medical man we require is one who starts from the standpoint of health and has as his purpose an understanding of the nature of disease. But it is necessary to be more particular.

25. We require a man of high character, able and willing to maintain the true dignity of a great profession, and to live up to the high ethical traditions of Medicine; of good general education, of

* *Science and Education.*—Essays, Vol. III., 1902, pp. 244–246.

interest, activity and some *savoir faire;* a man of learning and knowledge in his vocation, with technical skill and medical experience; but above all a practical man, with ideas and application, with a forward-looking mind, able to participate in the growth and development of medical science, trained in the scientific method and inspired by the scientific spirit—in other words a man of accurate observation, of ability in experimentation, and of sound judgment and interpretation. We have now to consider what these general terms imply, for only upon a clear understanding, almost a definition, of the type of medical practitioner we require, can we establish a curriculum and a system of education, narrow in its engagement as regards the limited time available, but comprehensive in character.

26. It will be convenient to set out the requirements *seriatim* in some such form as follows. The competent and well trained medical man must have:—

(*a*) A knowledge of the body and mind in health and of the physiological laws which govern it.
(*b*) A knowledge of the body in disease (for subdivision *see* below).
(*c*) An understanding of the principles and practice of preventive medicine.
(*d*) A sense of the relation of the individual to the community.
(*e*) An alert faculty of research.

27. The component parts of this desideratum are dealt with in the different sections of this Memorandum. Here it is only necessary to say that its principal propositions have relation to Health on the one hand, to Disease on the other. The medical man must be first and last, and all through, a biologist, and adept in that particular branch of biology known as physiology. Anatomy and physiology are the bedrock of Medicine; they will be reached through biology, physics and chemistry; they will lead on inevitably to the advanced subjects of his study. But everything will depend primarily upon a comprehensive and working knowledge of the body and mind in health. That is the foundation upon which alone the student can build his understanding of disease; and his knowledge of the body in disease must at least include the following:—

(i) *A scientific knowledge of the nature of disease*, of cellular pathology (macroscopic and microscopic, physical and chemical), of functional and organic disease, of infective and non-infective, of the early and late stages of disease.

(ii) *The signs and symptoms of disease*, a study of the patient at the commencement of disease, the early physical signs and subjective symptoms of the beginnings of disease, a study of the progress of disease and its later forms and indications. Before all things the practitioner must be a competent diagnostician and thoroughly skilled in methods of clinical examination and investigation and the use of the ordinary instruments of observation. Particularly should he be familiar with the differential diagnosis of the commoner maladies.

(iii) *The treatment of disease*, the principles and practice of medicine (including pharmacology and therapeutics), the practice of minor surgery and surgical dressing; the whole management

of midwifery, and the whole treatment of fevers. The every-day care of the patient in disease, particularly in infancy and childhood.

(iv) *Prognosis.* — This branch of practice is liable to neglect, yet upon it depend the circumstances of the patient's immediate future and his capacity for undertaking the duties of his normal life. The future of the disease and the future capacity of the patient should not be confused, though both are involved in prognosis.

(v) *What the signs of death portend.*—Each practitioner must be sufficiently skilled in autopsy work to interpret its findings, for the signs of the dead body furnish invaluable data from which it is desirable sometimes to explain diagnosis, sometimes to justify, and always to learn. Every death from conditions other than old age should be the occasion of new knowledge to the practitioner.

If this be the type of medical practitioner the times require, the question arises, what kind of education will produce such practitioners? It is clear the commonwealth does not require two standards of medical man, one having received an inferior form of training and another a superior form. *All medical education should be fundamentally one and the same in regard to basis, technique and spirit.* No doubt one man will subsequently proceed to higher or more numerous degrees and qualifications than another, and with greater natural gifts will produce greater results; but all practitioners of medicine require a minimum of comprehensive training, the same elements of scientific method, a similar scientific inspiration. The answer to the question is complex, but in a word it is a university education in Medicine. And the foundation of such an education is science. "Those who are enamoured of practice without science," said Leonardo da Vinci, "are like a pilot who goes into a ship without rudder "or compass, and never has any certainty where he is going. Practice "should always be based upon a sound knowledge of theory, of which "perspective is the guide and gateway."

SECTION III.

A UNIVERSITY EDUCATION IN MEDICINE.

28. A University education in Medicine implies certain peculiar conditions, and these must now briefly be discussed; and in discussing them it will be necessary to maintain a fair measure of detachment from all questions of examination and degrees of qualification. We have to deal with the subject of what is in fact the method of medical education most likely to yield the desired product. And in so doing we must consider the problems which face us with caution and some circumspection as well as with frankness. Amid the conflict of proprietary interests, of venerated tradition and long-established conventions, of not unfriendly college and hospital rivalries, and of innumerable cross-currents, we are liable to miss our way unless we keep clearly and always in view, as our pole star, the purpose and nature of a sound education in medicine. It is this, and not the current and ever-changing contentions of the time, which must serve as our guide. Now, it is evident from the considerations advanced in the previous section that the medical man who has received an adequate education must have something more than learning. He must be also a skilled craftsman, and, knowing his way among men, he must be, in a general sense, a humanist. Hence we must think of him as requiring, like other university men of his own age, the advantage which University life brings as well as an adequate and practical training in professional subjects. Many of the difficulties and shortcomings of the past have been due partly to an attempt to turn out merely an adept technician, and partly to over-loading the professional curriculum in regard to information to be acquired to the detriment of real training in science and the scientific spirit. Yet it is this, and not an encyclopœdic store of information, which is the desideratum. "The "very hopelessness of thorough mastery brings out in clear relief the "fact that medicine is scientific," wrote Mr. Flexner, "not because of "this or that positive possession in the shape of knowledge, but by "reason of its adherence to and exemplification of a certain method. "It matters little what particular facts the student knows at graduation, "for he can in any case know comparatively few, provided intensive "training in a few branches has fixed a keen and sound mental dis-"position. If he has contracted the inquiring habit, if he can detect "logical error, if he can use his senses and his fingers, he has been "well educated in essentials. He gets such an education by doing "a few subjects thoroughly rather than by doing many super-"ficially."*

29. For convenience we may group the principal requirements of a university education in medicine as they concern (i) the pursuit of learning, (ii) the methods of instruction, and (iii) a scheme of work for both undergraduate and subsequent training.

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* Medical Education in Europe, 1912, p. 90.

(i) *The pursuit of learning in Medicine.*

30. The service of the public requires a well-informed and skilful doctor, but also an educated man, and before the professional training, and also as part of it, there must be a general equipment, adding not only to the pleasure and usefulness of life but also to the standard and character of the medical training built upon it. It is clear that this calls for a sound preliminary education in school, which shall instil the love of knowledge and the use of the tools of learning. But the spirit of learning in the wider sense is obtainable only at a university, for there is left behind the rule of thumb, the didactic, the mechanical form of instruction, and there is found the aim of the attainment of truth and its advancement. The medical student is and must be utilitarian in purpose; but it is essential to his proper professional education that it should be deeply infused and inspired by the broadest and most liberal culture, from which he may derive mental discipline, scientific habit and an intellectual mastery of the principles involved in his profession; what may be called a clear, calm, accurate vision and comprehension of all things bearing upon his calling, which shall give him not learning only or acquirement only, but the possession of the thought, the reason, and something of the philosophy, of Medicine.

31. There are three descriptions of this sort of university teaching which may be quoted as illustrating the point under consideration. The first is from a Report by two of the Board's Inspectors in 1910, which is as follows:—

> "We may assume," they say, "that university teaching is teaching suited to adults; that it is scientific, detached, and impartial in character; that it aims not so much at filling the mind of the student with facts or theories as at calling forth his own individuality, and stimulating him to mental effort; that it accustoms him to the critical study of the leading authorities, with, perhaps, occasional references to first-hand sources of information, and that it implants in his mind a standard of thoroughness and gives him a sense of the difficulty as well as of the value of truth. The student so trained learns to distinguish between what may fairly be called matter of fact and what is certainly mere matter of opinion, between the white and the coloured. He becomes accustomed to distinguish issues, and to look at separate questions each on its own merits and without an eye to their bearing on some cherished theory. He learns to state fairly, and even sympathetically, the position of those to whose practical conclusions he is most stoutly opposed. He becomes able to examine a suggested idea, and see what comes of it, before accepting it or rejecting it. Finally, without necessarily becoming an original student, he gains an insight into the conditions under which original research is carried on. He is able to weigh evidence, to follow and criticise argument, and put his own value on authorities."*

The second quotation is from an address by Sir Clifford Allbutt, Regius Professor of Physic at Cambridge, delivered to a gathering of medical students at King's College, London, in 1905:—

> "University training differs from technical, not so much in the kind or field of subjects taught as in the more comprehensive, more deliberate, and more disinterested methods of teaching them; in the wider outlook upon them, and the awakening of curiosity and research. Thus, I reiterate, it is not so much what is taught as how it is taught. Nevertheless, within limits it remains true, and even obvious, that for the best education a complete general training in fields other than those of the future calling must bring

* Special Report on certain Tutorial Classes, 1910, No. 2.

about a richer result. . . . It appears then that the function of university education is not special instruction in the lines of a profession or trade, however these ends may substantively be promoted, but in expanding and enlarging the mind and making it a more and more perfect instrument of knowledge and progress, whatsoever its destination"*

The third quotation is from one of the well-known lectures by John Henry Newman before the Catholic University of Ireland in 1852. Speaking of the purpose and result of such university education, the writer says:—

"If then a practical end must be assigned to a University course, I say it is that of training good members of society. Its art is the art of social life, and its end is fitness for the world. It neither confines its views to particular professions on the one hand, nor creates heroes or inspires genius on the other. Works indeed of genius fall under no art; heroic minds come under no rule; a University is not a birthplace of poets or of immortal authors, of founders of schools, leaders of colonies, or conquerors of nations. It does not promise a generation of Aristotles or Newtons, of Napoleons or Washingtons, of Raphaels or Shakespeares, though such miracles of nature it has before now contained within its precincts. Nor is it content, on the other hand, with forming the critic or the experimentalist, the economist or the engineer, though such, too, it includes within its scope. *But a University training is the great ordinary means to a great but ordinary end*: it aims at raising the intellectual tone of society, at cultivating the public mind, at purifying the national taste, at supplying true principles to popular enthusiasm and fixed aims to popular aspirations, at giving enlargement and sobriety to the ideas of the age, at facilitating the exercise of political power and refining the intercourse of private life. It is the education which gives a man a clear conscious view of his own opinions and judgments, a truth in developing them, an eloquence in expressing them, and a force in urging them. It teaches him to see things as they are, to go right to the point, to disentangle a skein of thought, to detect what is sophistical and to discard what is irrelevant. It prepares him to fill any post with credit and to master any subject with facility. It shows him how to accommodate himself to others, how to throw himself into their state of mind, how to bring before them his own, how to influence them, how to come to an understanding with them, how to bear with them. He is at home in any society; he has common ground with every class; he knows when to speak and when to be silent; he is able to converse, he is able to listen; he can ask a question pertinently, and gain a lesson seasonably, when he has nothing to impart himself; he is ever ready, yet never in the way; he is a pleasant companion, and a comrade you can depend upon; he knows when to be serious and when to trifle, and he has a sure tact which enables him to trifle with gracefulness and to be serious with effect. He has the repose of a mind which lives in itself, while it lives in the world, and which has resources for its happiness at home when it cannot go abroad. He has a gift which serves him in public, and supports him in retirement, without which good fortune is but vulgar, and with which failure and disappointment have a charm."†

Probably of very few men could it be said that Cardinal Newman's noble passage found a true bill. But to a vast multitude of men and women some measure of this spirit and attitude of mind has been vouchsafed by a university education, and certainly none can read his eloquent tribute without recognising, in clause after clause, the image of the perfect physician. Long ago Hippocrates declared the four qualities indispensable to the good physician to be learning, sagacity, humanity, and probity, and much, though not all, of these roots of medical honour may be found in a true university education.

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* *On Professional Education with special reference to Medicine*, 1906, pp. 37–45.

† *The Idea of a University: Discourse vii. Knowledge viewed in relation to professional skill*, 1852, page 177.

32. But this is not all. Locke and Sydenham, representing the theory and practice of Medicine in their day, taught that, over and above the university spirit and a university standard of learning, the medical student requires (i) a training in observation and the inductive method, (ii) exercise and practice in his craft, and (iii) some apprehension of the *rationale* and laws and limitations of Medicine. His dormant faculty of observation will be awakened in his preliminary study of science, and indeed all through his medical curriculum it can be trained and stimulated to become a talent and a habit of keen, serious, patient, continuous seeking, of honest perceiving and of valid reasoning. The student must also have ample opportunity of everyday practice. Medicine is the art of healing not less than the science of disease. "Our art," wrote Sydenham to Dr. Mapletoft, "is not to be better learned than by its exercise and use"—not an exercise of healing only in the sense of curing a particular patient, but of learning from each patient increased power in the art of healing all similar patients.

33. And a further acquirement will be necessary, namely, the understanding of the limitations of medicine. In his day Sydenham criticized his fellow practitioners because they forsook "the ancient method of cure, founded upon the knowledge of conjunct causes"; their temptation was to be engrossed in the search for remote and ultimate causes instead of conditions which were at hand; his advice was to act on the "immediate and conjunct causes within the compass of our knowledge." In other words, both the science and art of Medicine suffer from the embarrassments of ever growing and expanding themes, and of the infinite number and variety of idiosyncrasies, heredities, and circumstances governing health and disease in each individual. "The chief deficiency of Medicine," wrote Sydenham, "is not want of efficacious medicine. Whoever considers "the matter thoroughly will find that the principal defect on the part of "physic proceeds not from a scarcity of medicines to answer particular "intentions, *but from want of knowing the intentions to be answered.*" And so he gave himself to the minute study of the natural history of disease and the difference in constancy and value of its symptoms, recognising the limitations of his knowledge and the relative empiricism of his treatment. Thus also must his followers do.

34. It must be borne in mind that there are limitations which attend the philosophy of the practice of medicine. It is not a science which is wholly inductive, nor yet a complete science of any sort, and it is not constituted in its entirety of clear-cut reasoning. Medieval medicine was notional, quasi-metaphysical, and largely deductive; modern medicine is based more largely upon inductive reasoning (observation, classification, deduction, verification), but in practice it results in a use of both processes and not a little empiricism. The true method is that the student should be trained (i) to collect his facts, (ii) to check his facts by observation and the experimental method, (iii) to classify his facts, (iv) to draw his deductions, and most of all (v) to standardize his deductions by the plumb line of experience. It is this last proposition which is liable to be ignored. "We were taught in a theoretical way the treatment of disease," said a competent London practitioner the other day, "but we ought to have been taught above "all the treatment of the *patient.* Our primary daily business is *to* "*relieve the condition of the patient.*" There is not a little truth in

this view, and it reveals not so much a lack of the scientific spirit in medical training as of its proper application; it suggests that much of our teaching is remote and immaturely academic, and that the student discovers in after-life that logic and conjecture are poor makeshifts for sound practice and experience. It is interesting to remember that 300 years ago Francis Bacon wrote that "Physic is situate in a *middle* "*term* or distance between history and metaphysic. For natural "history described the variety of things; physic the causes, but variable "or respective causes; and metaphysic the fixed and constant "causes. . . . The pith of all sciences, which maketh the artsman differ "from the inexpert, is in the *middle propositions*, which in every "particular knowledge are taken from tradition and experience."*

35. In formulating schemes for placing medical education on a scientific basis it is necessary to bear these points in mind and give place to the "middle term," and in so doing follow the example of Hippocrates, Sydenham, Abernethy and Baillie. The student, in other words, must study by the scientific method, assimilate the findings which it yields, and then so practise his art as to secure from it the maximum effect, immediate and remote. And this assimilation and this practice must be allowed for in the training of the medical student. "Medicine, throughout all its departments, is a science of observation," wrote Professor Syme to Sir James Graham, when the Medical Act of 1858 was before Parliament; "memory alone, however retentive, or diligently "assisted by teaching, is unable to afford the qualifications for practice, "and it is only by *digesting the facts learned, through reflection, "comparison and personal research*, that they can be appropriated with "improving effect; but when the mind is loaded with the minutiæ of "elementary medical and collateral study, it is incapable of the intense "and devoted attention essential to attaining any approach to excel-"lence in practical medicine and surgery. It has accordingly always "appeared to me that the character of medical men depends less upon "what passes during the period even of studentship than upon the "mode in which they spend the next years, when, their trials and "examinations being over, the whole strength of a young and "disciplined intellect may be preparing itself for the business of life."

(ii) *Methods of University Instruction in Medicine.*

36. The administrative conditions which will provide some guarantee that the education supplied is of university standard are relatively

* Advancement of Learning, 1605. In Bacon's own period Locke advised that, "for the saving the long progression of the thoughts to remote and first principles "in every case, the mind should provide itself several stages, that is to say *inter-"mediate principles*, which it might have recourse to in examining those positions "that come in its way." (On the Conduct of the Human Understanding.) And in our day Mill wrote in his Logic: "Art selects and arranges the truths of science "in the most convenient order for practice, instead of the order most convenient for "thought—science following one cause to its various effects, while art traces one "effect to its multiplied and diversified causes and conditions. There is need of a set "of *intermediate scientific truths*, derived from the higher generalities of science, "and destined to serve as the *generalia* or first principles of art. The art proposes "for itself an end to be gained, defines the end, and hands it over to science. "Science receives it, studies it as a phenomenon or effect, and, having investigated "its causes and conditions, sends it back to art, with a *rationale* of its cause or "causes, but nothing more. Art then examines their combinations and forms a rule "of action."

simple. The University is a place where students work in constant association with their fellow students, preferably of other Faculties as well as their own, and in close contact with their teachers; and they pursue their studies when young and able to devote their whole time and strength to them. A second condition concerns *the quality and status of the teachers;* they should possess not only high academic qualifications in learning and skill of craft, but also undoubted pre-eminence as teachers, and this and not anything else should be the merit which places them in authority. They should be appointed, paid, and, where necessary, dismissed by the University. The teachers of the fundamental Sciences should devote their whole time to teaching and research, and the Clinical teachers should not be trammeled with the insistent claims of a large practice.

> "It is necessary that the terms of their appointment and employment should be suitable. Experience has shown that the University cannot be certain of securing suitable conditions for the teachers when they are paid for by bodies over which it has no financial control. The first necessity is therefore that the University should provide its own teaching by which we mean that it should appoint, pay, pension, and dismiss its teachers, and not leave these primary duties in the hands of independent corporations. With this control in its hands the University may be trusted—
>
> "(i) to choose its staff for individual excellence from the widest possible field;
>
> "(ii) to give them such remuneration, including superannuation, and such conditions of tenure as will free them from the pressure of material anxiety;
>
> "(iii) to arrange that their teaching duties leave ample time for their own individual work;
>
> "(iv) to arrange that the libraries, laboratories, and other means of assistance provided for them are such as to permit of advanced work and research; and
>
> "(v) to give them a voice in the selection of their colleagues." *

Thus the University should have control both of finance and of staff. A third condition is that all teaching of university standard should be carried on *under favourable conditions*, of which the following may be mentioned as of vital importance in Medicine:—

(*a*) that the several departments must be adequately equipped and properly supplied with the necessary material;

(*b*) that in each department the instruction shall be arranged to include a proper amount of theoretical, practical and clinical work;

(*c*) that the departments shall be effectually co-ordinated, and that laboratories and clinics of university standard both "intermediate" and "final" shall be intimately interwoven. This co-ordination should obtain between laboratories and departments of a University, between the University and the hospitals used for instruction, and between Universities working for the same purpose. Strict preserves and water-tight compartments do not contribute to the advancement of knowledge or to the betterment of medical education.

Lastly, university teaching is ultimately synthetic and works towards universal ends. It is not a mere cramming place or "grind shop."

* Final Report of Royal Commission on University Education in London, 1913, page 46. Subsection (v) is represented at Cambridge by Boards of Electors

Its business is the increase of knowledge and the drawing out of the student to the highest of his capacity. And to this end the professor of medicine in a university school must himself be the ripe fruit of a true education, of a wide experience and of a high morality.

> "I do but say," declared John Henry Newman, "that there will be this distinction as regards a Professor of Medicine, in a University and out of it, that out of a University he is in danger of being absorbed and narrowed by his pursuit, and of giving Lectures which are the Lectures of nothing more than a physician, whereas in a University he will just know where he and his science stand; he has come to it, as it were, from a height, he has taken a survey of all knowledge, he is kept from extravagance by the very rivalry of other studies, he has gained from them a special illumination and largeness of mind and freedom and self-possession, and he treats his own in consequence with a philosophy and a resource, which belongs not to the study itself, but to his liberal education."*

In short, the teacher in a University is the pivot of the method. He must be learned in his subject, skilled in craft, competent in administration, experienced in research, and catholic in mind. He should reach his post not by favour, by merit of age or seniority, by social convention, but chiefly because he is a teacher and leader of men.

(iii) *A University Curriculum in Medicine.*

37. The third requirement of a University Education in Medicine concerns the scheme of work. In England it is the universal practice to divide this into Preliminary Scientific Studies (chemistry, biology and physics), Intermediate or Fundamental Medical Studies (anatomy, physiology and pharmacology), and the Advanced Medical Studies (Pathology, Medicine or the Practice of Physic, Surgery, Obstetrics and Gynecology, and Preventive and Forensic Medicine.†) There are also a number of special subjects of great importance (vaccination, fevers, mental diseases, diseases of children, ophthalmology, &c.) which should form an integral part of a medical curriculum, and instruction in which there is an undesirable tendency nowadays to separate too definitely from the main subjects of training.

38. The form of the curriculum varies somewhat in the two principal types of Medical School, whether it be a Hospital School (to which type the twelve medical schools in London belong) or a University Medical School (to which type the principal schools in the provinces

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* *Idea of a University*, page 166.

† The syllabus prescribed for Examinations for Medical Degrees in the University of London (M.B., B.S.) comprises (1) Inorganic, Organic and Applied Chemistry, (2) Physics, (3) General Biology (*forming first Examination*); (4) Human Anatomy and Embryology, (5) Physiology, (6) Pharmacology, pharmacy and materia medica (*forming second Examination*); (7) General and Special Pathology, including bacteriology and parasitology, (8) Principles and Practice of Medicine, including clinical medicine, therapeutics, vaccination, &c., (9) Fevers, (10) Insanity, (11) Principles and Practice of Surgery, including clinical, operative and applied surgery, anæsthetics, &c., (12) Diseases of Eye, Ear, Throat and Skin, (13) Midwifery and Diseases of Women, (14) Forensic Medicine, (15) Hygiene (*forming third Examination*).

For the London Conjoint Qualification of the Royal College of Physicians and Surgeons (L.R.C.P., M.R.C.S.) the prescribed subjects are similar, but Pharmacy is included in the first Examination.

The Medical Schools attached to Universities in the provinces prescribe a like course of study, though in some cases pathology is included in the intermediate group rather than the final group.

belong). It is necessary to bear in mind the difference between these two types. The London Medical Schools* had their origin, with one or two exceptions, in the informal arrangements of the medical staffs of the hospitals arising out of the apprenticeship or pupilage system. Men who had served an apprenticeship to an apothecary or practising doctor took a course of hospital work in conjunction with study at one of the various anatomy schools then existing in London. The authorities of the hospitals permitted their medical and surgical staff to have pupils in the hospital, and this proving advantageous to the hospital (for the students undertook much of the work of the hospital service) assisted in providing buildings and appliances for the establishment of a medical school within or adjacent to the hospital precincts. The fees of the students went to the maintenance of the school and the payment, on a share basis, of the teachers. Even the intermediate subjects were taught by the senior or junior members of the clinical staff, and special provision had to be made for instruction by experts in chemistry, physics and biology. As the curriculum became longer and fuller the expense entailed naturally increased, and the remuneration of the clinical teachers declined. They continued, however, to discharge the function of teaching, partly because of loyalty to their school and partly because of the indirect but substantial advantages which accrued in their consulting practice by membership of the hospital staff, to which they earned promotion by the lapse of time and the retirement of their senior colleagues. Such circumstances and their high professional standing, and not necessarily their powers of teaching or their experience in research work, often led them to become teachers of Medicine or Surgery. The position which thus arose through a happy mixture of philanthropy and interest was a stage of the evolution of the apprenticeship system; it was in fact a communal apprenticeship system. "The staff became a Faculty," it has been well said; "the apprentices became clerks and dressers." It had both advantages and disadvantages. It brought the student to the patient, under supervision of an experienced clinician; but it led, of course, to "inbreeding" of a staff by no means universally competent to teach, and in some cases to indifferent and perfunctory teaching of a technical and not a university standard. The teacher in fact was not necessarily qualified to teach, even his ambition lay elsewhere. "The incapacity " of the teachers," wrote Huxley in 1890, "is the weak point in the " London schools. But what is to be expected when a man accepts " a lectureship in a medical school simply as a grappling-iron by which " he may hold on until he gets a hospital appointment."†

The history of the provincial medical schools had a somewhat similar origin, but in their case a university, as a teaching institution, was at hand or could be constructed, and an association and a control readily set up, which brought the medical school within the compass of the university body. The final stage is not complete in all cases, but in all cases there is a closer association between the teaching of medicine and the university than in London, and, therefore, a more

* Systematic lectures were first commenced in the following years (*circa*):— St. Thomas', 1718; St. Bartholomew's, 1734; St. George's, 1831; London, 1749; Guy's, 1769; Charing Cross, 1822; University College, 1826; Westminster, 1834; Middlesex, 1835; King's College, 1839; St. Mary's, 1854; School of Medicine for Women, 1874.

† Life and Letters of T. H. Huxley, vol. iii., p. 165.

compact and co-ordinated scheme of education. It is a progress towards complete university status.

In subsequent sections of this Memorandum some observations are submitted for consideration regarding the methods of teaching the principal parts of the medical curriculum. The present section is concerned only with the general requirements of a university standard of education, and in relation to the curriculum there are two important matters to which reference must be made. The first is the need for a homogeneous and properly related course of study; the second has regard to the relation of examinations to teaching.

39. *Necessity of Effective Co-ordination.*—First, a University course, in medicine more than in any other subject, demands an effective inter-relationship between the constituent studies—in this case preliminary, intermediate and advanced. For instance, there must be adequate and closely associated accommodation (*a*) for chemistry, biology and physics; (*b*) for anatomy, physiology, pharmacology and pathology; (*c*) for routine clinical work in the hospital, and (*d*) for research and active co-ordination of these various subjects. As we shall see in a subsequent section, the immediate need of English Medicine lies in the application of the findings of the laboratory, for medical knowledge is complete only when it embraces the chemical and pathological as well as the clinical facts of the case. Another essential condition of a university medical education is a close and living relation between the fundamental subjects of anatomy and physiology and the clinical study and experience based upon them. Again, it is equally necessary to organize effectively the clinical study itself. We have seen that there must be learning and there must be proper methods of university administration. But not less necessary is a professorial department providing for clinical practice, clinical teaching and clinical research. It is relatively immaterial how this is contrived, provided that there is a clinical professor with control of wards and an out-patient department, with laboratory accommodation and with an adequate staff of competent assistants whose chief or only duty is to the department, and that the scheme of education comprises—

(*a*) scientific teaching in Medicine and Surgery by systematic clinical instruction (by practical demonstration or otherwise); and

(*b*) the English system of "apprenticeship" in the form of clerking, dressing and hospital appointments by which every student gains free and continual access to the patients both in the receiving room and at the bedside.

The plan of casual, indiscriminate or haphazard tuition in Medicine is doomed, and in the best Schools is, happily, already dead. It cannot yield the medical man of university standard; it cannot now produce even a fair general practitioner. Nor is it sufficient to organise thoroughly the intermediate subjects, but offer the student no more than a roving commission through the wards in search of clinical experience. The teaching of the clinical subjects needs organisation as much as and, because of the inherent difficulties, even more than the intermediate.

40. *The Relation of Examination to Teaching.*—A second matter concerns the thraldom of the present system of Examinations. It is not too much to say that in every medical school in this country

the teaching is too largely standardized on a basis of examination test. "*Examinations are a subsidiary function*," said the Commissioners on University Education in London in 1913, "*which can never take the place of education and may very easily injure it*," which is another form of Huxley's saying in 1874 that "Examination, like fire, is a good servant, but a bad master." In Medicine at the present time it cannot be said that the examinations are subsidiary, or that they do not injure education. Their influence is omnipresent and not seldom dominant; and in many cases they prescribe, restrict and even nullify the course of education, bringing in their train all the pernicious influences and evils of the cramming system. In college calendars one still finds the course of study introduced by such words as "the examination will include the following subjects." It falls outside the province of the Board of Education, and therefore of this Memorandum, to deal with this great question of examinations in Medicine. But a real university standard is unattainable until and unless examinations follow and do not lead the curriculum. The vital and ultimate issue is not, has this man passed such and such tests, but is this man a competent and well trained medical practitioner? Some degree Examinations, some test of efficiency, is, of course, essential. But it may well be that such a test, instead of being momentary, unequal and hazardous, should be prolonged, equitable and relatively certain in its application—a test comprising as its chief factor the whole training and record of the student throughout his course, the form and content of the curriculum, the work done, the preparations made, the hospital cases clerked and dressed, the practical examination of the class and so forth; an examination which would be not a test of certain branches of information only, but of learning and knowledge, of ability to think, of technical skill and craftsmanship, of actual individual experience of the human body in health and disease. Such a test conducted by his teachers and an external assessor would alter the whole outlook of the student; it would move his centre of gravity from the examination hall to the classroom, the laboratory and the ward; it would translate into an experience a liberal education in Medicine wide and deep and permanent; and it would assure the devotion of his teachers to the highest and not the lowest plane of a training in the scientific method and the scientific spirit. There is one further word to be added. Such a reform in examinations depends upon a new spirit in teaching, for it is to the practice of the great Medical Schools, not to examination tests, that we must look for the maintenance of high ideals in Medicine. These ideals must be the product of a growth from within; they cannot be imposed from without.

SECTION IV.

THE PRELIMINARY SCIENCES.

41. It is admitted by all authorities that the study of Chemistry, Physics and Biology forms the only appropriate introduction to the study of Medicine. Their elements played a primitive part in the days of Hippocrates and even before; Wootton, Caius, Mayerne and Gilbert kept alive the flame when the Middle Ages ended and the Renaissance began; and in our own day Professor Huxley appeared as their advocate. Their value in Medical Education is twofold; first, they afford a discipline, the practice of doing and working of the scientific method, and, secondly, they provide the elementary data upon which anatomy, physiology, pharmacology and pathology are constructed. The more Medicine advances the more its organic relationship with these subjects is revealed. "Their *subject matter* is a large moiety of "the Universe," said Huxley in 1854, "its *position* is midway between "the physico-chemical and the Social Sciences. Its *value* as a branch of discipline is partly that which it has in common with all Sciences—the training and strengthening of common sense, partly that which is "peculiar to itself—the great exercise which it affords to the faculties "of observation and comparison."*

42. Whilst there is no dispute, then, as to the necessity of these subjects to the medical student, there has been considerable divergence of view on two important issues, namely, what should be the content of each subject from the point of view of the adequate study of Medicine, and at what period of the student's curriculum should each subject be introduced? The question of content has resolved itself in the course of discussion during two generations into the synopsis of study as laid down in the Regulations relating to Degrees in Medicine in the University of London.

These syllabuses of study appear sufficiently formidable and elaborate.† They are somewhat closely followed in both the London and provincial schools, though teachers naturally and properly modify their courses in accordance with their own predilections. As a rule the theoretical and practical classes are concurrent, and the three subjects prove to be a considerable burden to the student. It is difficult, however, to eliminate or reduce the general scope of these essential studies. Possibly something may be done to reduce the number of types in biology, the calculations in physics and the tests in chemistry, but not substantially so without detriment. The methods of teaching

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* *Science and Education Essays*, Vol. iii., p. 59.

† They are too lengthy for insertion here, but *Chemistry* includes chemical methods, measures, weights, calculations, analyses, &c.; principles illustrated by oxygen, hydrogen, nitrogen, carbon, the halogens, sulphur, phosphorus, metals; qualitative and quantitative analysis, volumetric and gravimetric estimations; organic and applied chemistry, aliphatic and aromatic compounds, and various operations in practical chemistry.

Physics includes general physics, energy, solids, liquids, gases, specific gravity, atmospheric pressure, &c. Heat, light, sound, magnetism and electricity. Practical work in measuring and estimations of air, moisture, temperature, &c. Optics and electro-magnetism.

are somewhat similar in the three subjects, including systematic lectures and practical work. The method of teaching chemistry is well known; it consists of a course of lessons or lectures and practical laboratory work. A word may be said as to the teaching of Physics and Biology.

43. *Method of teaching Physics.*—An excellent example of the Method of teaching Physics is provided in the University of Manchester under Prof. Sir Ernest Rutherford. (i) The course of *Lectures* is given primarily to interest and to excite the scientific imagination of the student. It deals chiefly with the fundamental ideas of the subject and of the connection between them, and does not attempt to cover all the detail required by the student for his examination, for this can be better dealt with in the Revision Classes. The Lectures are illustrated as fully and as strikingly as possible by numerous experiments. In the case of Physics, such a course of lectures cannot fail to be of the greatest interest and value even to the dullest in imagination. (ii) In the *laboratory* the type of experiment is carefully chosen to illustrate the essential facts of the subject which admit of measurement with elementary apparatus. The apparatus itself is as simple as possible, so that the student takes nothing for granted about its construction. The practical work is prefaced by short "lecturettes" or printed summaries giving the object of the experiment and the theory underlying it, a practice generally followed elsewhere.* In this way, the student gets a clear idea of the object of experiment and of the special points requiring attention in order to secure accurate results. His attention is also directed to estimating the probable errors in the various types of measurement. (iii) A third form of instruction at Manchester is the *Revision or Exercise Class*, which plays an important part in the training of the medical student and especially for those who are taking physics for the first time. The Classes are small in number—not more than 20—and their subjects are (*a*) to revise the more important facts dealt with in the lectures and to assist the student in his difficulties by personal explanation; (*b*) to show the meaning and mode of derivation of the simple formulæ employed and to exercise the student in making simple calculations; (*c*) to train the student to express himself in scientific language and to grasp the distinction between essential and unessential points.

> "It must be borne in mind," explains Sir E. Rutherford, "that the student "comes in contact with the 'Lecture' system for the first time in the "University, and it takes time for him to adjust himself to the rapid covering "of ground which is so different from the slow, piecemeal methods used in "schools. No doubt, if the student received a preliminary scientific training "in school, the need of such Revision Classes would be reduced. However, "I am inclined to think they will always be necessary to help the mediocre "student over his difficulties and are, under present conditions, quite "indispensable." Prof. Rutherford adds: "I am of opinion that the subject "of Electricity and Magnetism is of increasing importance to Medical "Students and that, if possible, more time should be devoted to it. This "could be done if the student received a preliminary scientific training in "school. The time at present available is much too short, for electrical "ideas are difficult and abstract, and take time to grasp properly. As "Science advances, it is clear that electrical ideas and facts tend more and "more to exercise a dominating position and have an important influence in "Chemistry and even Biology. I think that the student should be given a

* This is admirably done in the Universities of Birmingham and Liverpool.

" general idea of modern scientific views. He should, for example, be told " something of the 'electron' and of the 'atom of electricity' and of their " important role in Electrical Theory. Obviously he should be told some- " thing of the nature and properties of X-rays, of Cathode rays and their " mode of production, and also the elementary ideas in connection with " Radium."

44. *Method of teaching Biology.*—Biology is taught in all Medical Schools on much the same basis. The biological types were introduced by Rolleston and Huxley in the South Kensington summer classes in practical biology in 1870, and have continued to prove valuable, though sometimes the method has been overdone. They stand also for something more than types, they illustrate biological principles. For instance, in the admirable biological department in the University of Manchester, the student is taught a dozen types, but in so doing his mind is drawn to the principles of comparative anatomy, embryology and what may be called the philosophy of the subject. Prof. Hickson's plan of lectures, like most other courses, deals with the subject after the manner of the syllabus of the University of London, which is as follows:—

(A.) The general structure, physiology and life-history of Amœba, Paramœcium, Monocystis, Obelia, Lumbricus, Scyllium, Rana, and Lepus.

The general structure, physiology and life-history of Hæmatococcus, Spirogyra, Pythium, Saccharomyces, and Bacteria. The reproduction and life-history of the Fern.

The anatomy, histology, and development of the vegetative organs of the dicotyledonous Plant, as illustrated by a herbaceous and a woody type. The structure of the flower as illustrated by that of Lilium, Ranunculus and Pisum. Reproduction, pollination, fertilisation, and development of the seed and fruit. Germination.

(B.) The cell, its structure and life-history in plants and animals. The elements of animal histology, as illustrated by the study of the tissues of a vertebrate animal, including epithelia, blood, and connective, skeletal, muscular, and nervous tissues.

(C.) The elementary facts concerning assimilation and metabolism, respiration, excretion, growth, irritability and movement, and reproduction in plants and animals. The experimental methods employed in elementary plant-physiology.

(D.) Sexual and asexual reproduction. Parthenogenesis. The history and characters of the germ cells. The elements of Vertebrate Embryology, with special reference to (*a*) cleavage and origin of the germ-layers in Amphioxus, Gallus, and Lepus; (*b*) formation of the fœtal membranes in Gallus and Lepus; (*c*) the outlines of organogeny, as illustrated by the study of Gallus as far as the end of the third day of incubation.

(E.) The elementary facts relating to heredity, variation and evolution.

(F.) The phenomena of saprophytism, as illustrated by Mucor, and of parasitism, as illustrated by Pythium, Bacteria, Monocystis, Malarial Parasite, and Tænia.

Professor Hickson includes in his course zoological classification, mammalian characters and the position of man in nature. He also treats of the characters of the Arthropoda and the principal features of the development of a placental mammal.

In each of the two terms there are 19 or 20 practical classes, concerned with the lectures, in which the types are dissected. In the practical class each student learns dissection, laboratory methods, microscopic work, and the careful drawing of each specimen. This last feature is important, as it serves to make more accurate the observation of the student, registers the impression on his mind, and inculcates ideas of form, differentiation and classification. A similar plan of course is adopted at Liverpool under the experienced guidance of Prof.

Herdman. There the declared object of the course is (*a*) to teach the fundamentals of biology, vegetable and animal, the types being used "as pegs for principles," and (*b*) to train the student in technique and skill in manual work and the use of the microscope. The lectures deal with protoplasm, metabolism, cell division, reproduction, heredity, evolution, and the types are illustrations, the *amoeba* as unicellular type of protoplasm, the *hydra* as multicellular, the *lumbricus* for segmentation, the *crayfish* for heteronomy, the *amphioxus* to introduce the vertebrates, and so on. The frog is the general type. I have seen no better work of its kind in Europe or America than in these two Schools, and of its educational value there can be no doubt. Professor Dendy, of King's College, London, (and other teachers concur) lays great store, and rightly, upon the teaching of the laws of heredity, particularly when taught alongside the general principles of organic evolution, thus leading the students' mind naturally to the whole question of the application of genetics to human life and affairs. Biology so taught is a liberal education. "Far too little time," says Prof. Dendy, "has been devoted in the past to "these more general and more interesting biological problems by the "medical student. This has been largely due to the excessive require- "ments of modern upholders of the type-system." It must be added that in a few medical schools the teaching of biology and physics leaves a good deal to be desired—it is of indifferent character, perfunctory, wooden, dominated by the type-system or the memorising of unimportant details, and little better than cramming for an examination.

45. The modern advances in our knowledge of parasitology—particularly in regard to malaria, yellow fever, plague, dysentery, sleeping sickness—and the relation of entomology, protozoology and helminthology to disease do not suggest a curtailment in the practical application of biology. Nor does the advance of chemical and experimental physiology or of the newer means of therapeutics make it desirable to reduce the preliminary study of chemistry and physics. A careful consideration of the various items of the scope of the course in physics set out in the Regulations of the University of London and other bodies will serve to confirm this view. The medical student must know about physical methods, heat, light, sound and electricity; he must be familiar with the mechanics of measuring temperature and atmospheric presssure, of the microscope, of the ophthalmoscope, and of the apparatus used in optics; he must know about surface tension, hydraulics, diffusion, osmosis, viscosity, and the colloid state; he must learn his way in electricity, in X-ray work, in radio-therapy mechanics, in high frequency currents, and so forth. Indeed, there is call for advance rather than curtailment. "I think it would be of great value," writes Professor Sir Ernest Rutherford, "if about the end of the third year or beginning of the fourth year, "all students were given a short course in Medical Physics. This "would include *inter alia* a discussion of methods and apparatus "used in electrical treatment, use of X-rays, radium rays, ultra-violet "light, &c., and also of physical apparatus used for special purposes. "The underlying theory and mode of use of apparatus would be "explained with experimental illustrations together with a discussion "of therapeutic effects. Such a course should preferably be given by "a medical man with a good knowledge of physics." There are similar proposals for advanced courses in medical chemistry in "continuation" chemistry leading to bio-chemistry (for physiology and

pathology) and in zoology (for parasitology, helminthology, tropical diseases, and diseases communicable by insects, flies, lice, fleas, &c.). The fact is, the preliminary science subjects are, with the exception of botany, expanding rather than contracting, and are now divisible into (1) a part suitable for Secondary School study, (2) a part which seems to belong to university study, and (3) a part constituting advanced technical application to practical medicine.

The place of the preliminary Sciences in the Curriculum.

46. In 1870, in an address on medical education at University College, London, Professor Huxley declared that the preliminary sciences —chemistry, physics and biology—"ought to be got rid of, as branches of special medical education; they ought to be put back to an earlier "stage and made branches of general education," and he added, "the "great step towards a thorough medical education is to insist upon "the teaching of the elements of the physical sciences in all schools, "so that medical students shall not go up to the medical colleges "utterly ignorant of that with which they have to deal."* In 1881, at the International Medical Congress in London, he again advocated this arrangement, urging that "somehow or other the "curriculum must be lightened. . . . The question is how this can "be done. My own belief is that if the Medical Council were to insist "upon a knowledge of elementary physics, chemistry and biology" in a two years' course prior to entrance to the medical schools "they would "be taking one of the greatest steps which at present can be made for "the improvement of medical education."† Finally, in 1889, Huxley said that "the student ought to have acquired, as part of his general "education, such knowledge of physics, chemistry and elementary "biology as is now demanded of him."‡ It is clear, therefore, what Huxley's view was on this matter, but it must not be forgotten that since his time immense improvements have been made in the teaching of these subjects in the medical schools, and that the advance of medical knowledge itself has shown a vastly more intimate relation between these subjects and practical medicine than was believed possible in Huxley's time. In recent years, however, there has been much debate on the question, the experts in the medical schools claiming that the subjects should be taught by them, and that the Secondary Schools were not sufficiently equipped for the purpose. Many educationalists and medical authorities, including Sir James Paget, on the other hand, claimed that the subjects should be taught in the Secondary Schools. In 1911 the General Medical Council finally decided to recognise teaching in preliminary science in approved secondary schools as qualifying for the first professional examination in medicine.§ We are

* Essays. Vol. iii., p. 318.

† Essays, Vol. iii., p. 341.

‡ University of London Commission, 1889. Minute of Evidence, p. 99.

§ "That it be an instruction to the Students' Registration Committee that when a Secondary School has been inspected and recognised by a licensing body, and has applied to be placed on the list of approved institutions in which medical study may be commenced, the Students' Registration Committee shall consider every such application, and when satisfied that the education in such Secondary School is of a sufficient standard, shall recommend such Secondary School to be placed by the Council upon the list of institutions in which such medical study may be commenced."—General Medical Council, May 29, 1911.

now, therefore, in the transition period of the open way, some students will study these subjects at certain Secondary Schools and others in the medical schools and universities, and time and experience will bring about an appropriate adjustment. There is much to be said on both sides. Professor Sir Ernest Rutherford writes as follows :—

"Since the teaching of medicine is largely based on the fundamental facts and theories of Physics, Chemistry, and Biology, it is obviously of prime importance that this fundamental instruction should be in the most competent hands. There is, in general, a marked difference in the type of instruction in Science given by the schools on the one hand and the Universities on the other. In the case of the majority of schools, the Science is Text Book Science retailed at second-hand, and the scientific knowledge and thought on which the instruction is based is in most cases old-fashioned, if not out of date. In the University, the instruction is given by a Scientific Expert, who is himself an investigator and is saturated with the scientific outlook of his time. Such teachers are in a position to emphasize the relative importance of fundamental facts and theories, to correlate them and to give the right perspective to the student. The teaching of such men is much more likely to arouse the interest and to leave a lasting impression on the student than a mere cramming of facts necessary to pass an examination. In addition, it is also well to mention that it is only in his scientific work in the first year that the Medical Student comes in contact with the teachers of pure Science in the University. Such contact, is, I think, important and tends to bring home to the student that medicine is not a subject apart from all others, but that its progress is indissolubly connected with advances in pure Scientific Knowledge.

"For these reasons, I am strongly of opinion that all Medical Students should take a course of Elementary Physics in the University in their first year. This, of course, does not mean that it is not important for the school to give good scientific instruction—quite the contrary. It would be of the greatest help to our work if all Medical Students, before entering the University, had an elementary knowledge of Mechanics and of the elements, say, of light, heat and electricity. On such a foundation the University could hope to build more strongly and permanently. More time would be available to devote to special topics in Physics of more direct practical value to the student; but it is hopeless to endeavour to treat of such subjects until the student has grasped the fundamental ideas of the main subject. Under the present conditions, when a large part of Medical Students receive no scientific instruction of any kind in schools, the short time available in the University is more than fully occupied in merely giving them the fundamental facts and theories, and there is no time for consideration of special topics. It would be of great advantage if all Medical Students, in addition to elementary Physics, had passed some qualifying examination in Mechanics before entering the University. The standard of such an examination need not be high—lower, for example, than that of the Matriculation—but it is essential that the student should be familiar with the ideas of force, energy and motion and the general properties of liquids before studying Physics proper.

"In the University here a large part of our Medical Students at entrance know nothing whatever of Mechanics, and the following procedure is adopted. All those who have passed the Matriculation in Mechanics or some other reasonable examination, or can show by a short examination that they have the necessary training in Elementary Mechanics, are exempted from further work on that subject. The remainder are given a special course for one term, illustrated, as far as possible, by experiment, and then pass a qualifying examination. There seems to be no reason why this work should not be done at schools and a qualifying examination passed before entering the University. This would relieve the University of work that can be done more slowly and systematically at schools, for the general arguments given in favour of University teaching in Physics proper do not apply to an elementary course in Mechanics."

47. Professor Herdman claims that the elements of science should be taught in all schools, but that advanced work and specialisation belongs

to the University. Professor Paterson, speaking as an anatomist, would have natural history taught at school where elementary knowledge of botany and zoology could be acquired in a general sense appropriate to an introduction to comparative anatomy and subsequently human anatomy at the University. "Breadth of view," he says "is thus obtained, "whereas under the present conditions all the student thinks of is how "to get up a minimum amount of knowledge of botany and zoology in "order to pass his first professional examination." Professor Dendy, of King's College, claims that whatever may be said in behalf of the importance of chemistry and physics, the teaching of biology is *primus inter pares* in relation to medicine, and he holds that "the teaching "of biology cannot be carried far enough in Secondary Schools to supply "a satisfactory foundation for medical studies." This is what he says:—

> "(1) Biology, dealt with as a foundation for medical science—including Anatomy, Embryology, Physiology, Hygiene and Genetics under the latter term—can hardly be taught in Secondary Schools in a really satisfactory manner, not only because of the lack of properly trained teachers and adequate laboratory facilities, but also because it should itself be based upon a foundation of Chemistry and Physics. The absence of any such foundation, and of the preliminary training in scientific thought and method which would accompany it, in many cases seriously handicaps the teaching of Biology to first year students even in the University. I have no doubt that the proper biological work for the Secondary School lies more in the field of Natural History and Elementary Physiology taken concurrently with Elementary Chemistry and Physics.
>
> "(2) Although Elementary Physics and Chemistry, together with Biology of the type above referred to, should be taught in Secondary Schools, I do not think that such teaching should be made the ground for keeping pupils at school beyond the matriculation age (16 or 17), unless, of course, they have no intention of proceeding to the University at all. A student who has passed the Matriculation Examination, with the appropriate subjects, is quite capable of profiting by University teaching, and should get far more benefit therefrom than he would by remaining at school. It seems to me that if a medical student began his University work at 17 there would be plenty of time for a year's work at Chemistry, Physics and Biology, based upon the foundations laid at school.
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> "I am afraid the present movement in favour of keeping boys and girls at school after they have matriculated is likely to be disastrous, at any rate in scientific education. Matriculation is the entrance examination for the University, and the sooner the student gets into the University atmosphere, after passing it, the better for him. The schools ought to be able to lay the necessary scientific foundations for the first year's University Course by the time the pupil reaches the matriculation standard, and if they do their work properly it should make possible the omission from the first year's medical curriculum of much elementary matter, and its replacement by matter having a more direct bearing upon medical work."

By way of summary it may be said that the disadvantages of including the preliminary sciences, and particularly biology, in the Secondary School are (*a*) the inadequacy of equipment and the absence of expert staff in most Secondary Schools, (*b*) the Secondary School teacher in biology cannot usually be a research worker and cannot keep in touch with the medical course or advance in medicine, and (*c*) the absence of a University atmosphere and of University methods of teaching.

48. On the other hand, it must be borne in mind that all authorities are now agreed that the *elements* of the preliminary sciences should be taught in the Secondary School, and that there is need to unload the

medical curriculum. Further, there are able and experienced teachers, including many medical authorities, who advocate the transference of the preliminary science subjects to the Secondary School, where they may be studied at more leisure and over a period of two years. The Royal Commission on University Education in London, concluded that "the study of the preliminary sciences should not be included "in the medical curriculum; that the undergraduates should not be "admitted to the Faculty of Medicine in the University until they "have received thorough instruction in the principles of pure science; "and that, whenever it is possible, the best time and place for "this instruction is the last two years of a good Secondary School course."*

The Commissioners made some reservation in regard to biology, but thought that subject also could be satisfactorily taught in "the upper forms of the great public schools."

Conclusion.

49. Speaking generally, it would appear that the solution to this question may be found in the following conclusions:—

(i) That the foundations of Chemistry, Physics and Biology for the medical student should be laid in the Secondary School in a thorough grounding in inorganic chemistry, in mechanics and elementary physics, and in nature study and botany. In most good Secondary Schools it will be found practicable to cover the necessary ground in Botany, of which the medical curriculum would thus be relieved; and in some Secondary Schools it will be practicable in two years to cover the ground of all preliminary science ancillary to Medicine, making it unnecessary for the student to devote any time at the medical school to the *preliminary* study of these basic Sciences. In this way it will be possible both to unload the medical curriculum and yet give the student a better start than formerly.†

(ii) Then at the University medical schools provisional facilities should still, for the present, be available for the study of the preliminary sciences, and also for practical specialization in physics, in organic chemistry and in biology, with a view to building a medical superstructure upon the foundation laid at the Secondary School.

(iii) In most medical schools it will be found practicable also to provide senior courses in medical chemistry and biochemistry, and in medical physics and in comparative biology and anatomy, in so far as such courses may be necessary.

(iv) It is desirable in the immediate future for most medical schools of University standard to integrate their preliminary science and bring it into closer touch with the four intermediate subjects—anatomy, physiology, pharmacology and pathology.

* Final Report of Royal Commission on University Education in London, 1913, p. 104. *See also* Report of Committee to enquire into the position of Natural Science in the Educational System of Great Britain, 1918, pp. 44–46. [Cd. 9011.]

† It is recognised that the situation in Scotland and Ireland in respect of Secondary School Education differs from that in England.

SECTION V.

ANATOMY.

Introduction.

50. After the decline in Greece of intellectual cultivation, Alexandria became the home of science and literature. The time in which it held this position included the reign of the Ptolemies from 323 to 30 B.C., and the subsequent period to the invasion of the Arabs in 640 A.D. The first period became an age of science, including medicine, the second was characterised by the neo-platonist philosophy. The Medical School of Alexandria became distinguished in the teaching of Human Anatomy owing to the work of two remarkable men, Herophilus and Erasistratus, who first dissected the human body, possibly even the living body, and thus added to the knowledge of elementary comparative anatomy which had been handed down from Aristotle. Galen, nearly two centuries later, dissected apes, and described human anatomy on the basis of data provided by the Alexandrian School. The Arabs followed Galen, and indeed the Galenic authority in Anatomy lasted throughout the civilised world for twelve hundred years and marked in turn the teaching of the Schools of Bologna and Salerno, though the latter School was permitted the dissection of the body in the thirteenth century. In the fourteenth century Mondino, of Milan, wrote his *Anatomia Mundini*, and public dissections became a custom at Bologna, Padua, and other Schools in Italy. During this period some attempt was made to interpret Galenic doctrine by reference to Nature, and as a result some halting progress was made, though the teaching of Anatomy was still dominated by the traditions of Galen, and little advance occurred between the death of Mondino in 1327 and the sixteenth century. The Study of Anatomy in the Middle Ages had to contend with serious difficulties, the lack of subjects for dissection, ecclesiastical opposition, and the implicit and blind faith in the written word of authority. In the fifteenth century Leonardo da Vinci and the painters revealed artistic and figurative anatomy; and in the sixteenth century dissection was legalised at the Hall of the Barber Surgeons in England, and abroad its teaching was carried on by Achillini, Carpi and Sylvius, the last-named being Professor of Anatomy at Paris. His most famous pupil was Andreas Vesalius (1514–1564), born of a Belgian father and an English mother, who became the founder of modern anatomy. He escaped from the thraldom of authority, and at Padua, Bologna and Pisa dissected the human body and described what he saw. "My "study of anatomy," he wrote, "would never have succeeded had "I, when working at medicine at Paris, been willing that the "viscera should be merely shown to me and to my fellow students "at one or another public dissection by wholly unskilled barbers, "and that in the most superficial way. *I had to put my own "hand to the business.*" In 1537 Vesalius was appointed Professor of Surgery and Anatomy at Padua, and drew disciples from all parts of Europe. In certain respects he followed the traditions of Galen, but where his dissection showed Galen to have been in error, he made new paths and taught in accordance with what he

saw. His physiology and much of his interpretation was thus Galenic, but his anatomical work was his own. In 1543, at the age of 28, and after lecturing several years at Padua, he published his *De Humani Corporis Fabrica*, in the following year he left Padua to become Court physician to Charles V., and in 1564 he was drowned at sea. Although his career in anatomy was brief, Vesalius had ended the dark ages of copyist and traditional writing, had established the new way of learning anatomy by dissection and by direct appeal to the body, and had opened the door to modern physiology. In a true sense he was the forerunner of Harvey, and although he was followed in the Chair of Padua by his eminent successors Fallopius and Fabricius, he left behind him the greatest name in Medicine in the sixteenth century. Henceforth the standard of the anatomist was not Galen's writings but the morphology of the body, not tradition but nature. The rise of Anatomy two thousand years ago in the School of Alexandria, its long period of stagnation and its renaissance sixteen hundred years later at Padua are a remarkable illustration of the truth that the foundations of science can be laid only in accurate observation and the faithful practice of the scientific method.

51. The study of the form and structure (*anatomy*) and the purpose and function (*physiology*) of the living human body lies at the basis of all true understanding of Medicine. They are both fundamental, but anatomy is primarily so, for it deals with the morphology in which and through which alone physiology can have practical meaning. Both subjects are inseparable and should be taught as interdependent. Pathology, pharmacology and the clinical subjects are a superstructure built upon a bed-rock of anatomy and physiology. In the whole realm of medical training there are two spheres, and two only, which form the essential anchorage of the scientific study of Medicine: the first is that which concerns the functioning of the normal body—anatomy and physiology; the second is that which concerns the functioning of the diseased body—pathology, the clinical subjects and therapeutics. We may specialise and subdivide as we will, we may introduce elaborate and theoretical lectures *ad libitum* and even *ad nauseam*, but the student will assuredly fail in after-life unless all through his training he be brought in direct and immediate contact with the living human body in health and in disease. The meaning of the Revival of Learning in relation to medicine and surgery is an escape from the trammels and domination of authority, of tradition and of abstract theory, and an acceptance of the return to Nature and of the careful study and investigation of things as they are.

52. But Anatomy is the basis of Medicine, not only because it is concerned with the morphology of the body in whole and in part, and in relation to its activity and development, but because the study of it is a discipline in science and technique, and because the subject forms an integral part of the daily practice of medicine and surgery. Like the study of physiology it introduces the student to the technical methods and manipulations of his profession and is a training in inductive science. Nomenclature and terminology are details of little importance, the mere machinery of communication; but an accurate and detailed knowledge of the body—the organism, the organ, the tissue, the cell—is of the essence of medical science. It is sometimes said, or implied, that anatomy becomes of less importance to the

student as the importance of the clinical subjects increases with growing knowledge. In truth the contrary is the case. Medical and surgical advance has accentuated rather than otherwise the necessity of thorough anatomical teaching. Yet in some schools and in many minds the subject of anatomy is conceived as it was conceived a century ago, in spite of the continued expansion of the subject and its application. The introduction of anæsthesia and the antiseptic method of surgery now make it possible to perform surgical operations—general, special, gynecological—undreamt of a century ago. Formerly they were hazardous and perhaps illegitimate; now they are within reach, practicable and relatively safe. But this means not that anatomy is less, but more necessary, both to the specialist and to the ordinary practitioner. Again, the new knowledge in regard to cardiac disease, neurology or tropical sickness, has given an added emphasis to the anatomy of the circulatory system, the nervous system, and the liver and spleen. Further, every clinical teacher is frequently demonstrating in one form or another, that a knowledge of anatomy is of daily necessity in appreciating physical signs and in differential diagnosis. Both its facts and its technique are alike required in general practice, in the out-patient department and in the hospital. "The very basis of the ordinary physical examination by a practitioner," says Professor Waterston, "rests primarily upon his "familiarity with the normal anatomy of the human body." Nor should the study of anatomy be conducted in an indifferent or perfunctory manner. "The [anatomical] department in a University" —wrote Professor Franklin Mall, of Johns Hopkins University, in 1908—"should be truly a University department and not one that "limits itself to instruction *which meets the bare needs of medicine and* "*surgery*. Were this the case we should return to the more economical "arrangement in which the modicum of anatomy is taught by a busy "practitioner, that is one who knows what is practical, during the "few spare hours a week he has to devote to anatomy as an avocation." The desideratum evidently is not learning in utilitarian anatomy only; but systematic anatomy, taught not from the standpoint of application only, nor for examination purposes only, nor as a specialism, but from the standpoint of science, comprehending a full, exact and working knowledge of the body machine as a whole, and of its meaning and purpose; in other words, a training and a knowledge of University standard.

The Content of the Subject.

53. In recent years there has been much discussion as to the content and scope of an Anatomical Department. Speaking generally, there is among all authorities general agreement that all medical students should at least receive adequate training in Elementary Human Anatomy, macroscopic and microscopic (that is Anatomy and Histology). In addition there should be, in the view of many competent teachers, either as compulsory sections of the subject or as "optional" (or in America "elective") courses of study, Comparative Anatomy,* Embryology, Topographical Anatomy and the Anatomy of Special Systems

* The scope of Comparative Anatomy and its relation to the Medical Curriculum must depend in large measure upon what is included in the course of Biology.

(neurological, genito-urinary, &c.). Whatever be the arrangement, it should be understood that the study of Human Anatomy in Medical Schools includes the elements of these several branches of the subject and their application in medical and surgical practice. Embryology has unfortunately been neglected in most English Medical Schools. No true understanding of the build of the body is possible without some apprehension of its ancestry, its origins, its development, its growth and its meaning. The amount and character of the Histology included with anatomy will vary in accordance with arrangement between the teachers of anatomy and physiology, but there is on the whole a growing tendency for all that concerns structure, microscopic as well as macroscopic, to pass into the realm of Anatomy, and there is little doubt that this is the proper course. These are matters, however, which will be readily settled if the teaching itself be right. In most English Medical Schools there has until recently been a tendency to confine the teaching of anatomy somewhat narrowly to elementary anatomy proper (excluding histology) with little more than passing reference to comparative anatomy and embryology. In all Schools it has been the practice to teach surgical anatomy. At Manchester Professor Elliot Smith's course has for some years included comparative anatomy, embryology, some histology, and gross or descriptive anatomy. Training in research work also forms a part of the course. In another British Medical School the usual elementary course is followed by an advanced course comprising a series of special dissections during a period of three months. This includes lantern demonstrations and discussions on such subjects as (*a*) embryology, (*b*) the development, variations and malformations of the several systems, osseous, circulatory, nervous, alimentary, &c., (*c*) the arrangement of the visceral moorings of the abdomen in the adult during development and factors determining variation, (*d*) the anatomy of the abdominal wall with special reference to hernia, (*e*) mechanism of respiration, (*f*) theory of the limbs, (*g*) mechanism of erect attitude, (*h*) anatomical basis of referred pain, and (*i*) surface anatomy. Advanced courses are now common, and should be universal, in Medical Schools, and are devoted usually to those parts of anatomy which are expanding—embryology, anthropology, and the structure of the nervous system, and to applied anatomy in medicine, surgery and obstetrics.

54. In 1912, Professor Mall divided his course at Johns Hopkins University into (i) human anatomy, studied by means of dissection during the first year of the medical course, without lectures, (ii) histology, commencing with living tissues as far as practicable, a dozen lectures, (iii) neurology and special senses, two dozen lectures and (iv) embryology, practical work and demonstrations. "My object " is to teach anatomical method," he said, "rather than insist on " memorizing facts." The required course was principally anatomy and histology, the elective courses included neurology, topographical anatomy, embryology, anatomy of the child, and so on. Comparative Anatomy was relegated to Biology. I was much impressed by the "research work" being done by the students as a valuable training in scientific ways and spirit, and by the "concentrative method" of devoting the best of the year to the individual study of anatomy under supervision. Von Baer, of St. Petersburg, in 1866, Waldeyer,

of Berlin, 20 years later, and Franklin Mall, of Baltimore, in our own generation, have all urged the same method—the concentration of anatomical study and continued self-instruction under guidance. Waldeyer recommended that the second professional year should be devoted wholly to anatomy and physiology. Practice varies in England, but as a rule anatomy is spread over two winter sessions. Be that as it may, the really desirable thing is first to concentrate the main attack on the subject and allow a minimum of interruption, and secondly, to continue in one way or another to bring the student back to anatomy (not necessarily to the dissecting room) all through his course, in physiology, in pathology, in surgery, in medicine. The student should always be taught to use Nature as his plumb line.

Methods of Teaching.

55. Observation of the teaching of Anatomy in many Medical Schools has convinced me that the difference between good and bad work is dependent on the recognition of two or three very simple principles, a recognition which, however, does not always exist, even in schools of the highest repute. There must first be ample opportunity for study, as regards both time and material*; next, the student must himself do the work, merely didactic lectures being useless in the teaching of anatomy†; thirdly, the requirement is an exact knowledge of the anatomy of the living and not the dead‡; fourthly, the teaching of anatomy to the medical student must continually be brought into relation with physiology, pathology and the clinical subjects, in order to give the right meaning and purpose to the work§; lastly, the course of anatomy must always illustrate two fundamental educational processes, analysis and synthesis, the breaking down and dissection of the machinery as well as its positive building up. The body has been likened to the mechanism of a watch, or a steam engine, or an army. It is all three, and much more; and the student must be led by analysis and synthesis to know his way through its wonderful paths. This last point is illustrated in a letter I received from Professor Paterson, head of the Anatomical School of Liverpool. "There are two ways in which the study of anatomy may be approached," he writes, "first, constructive; secondly, "destructive. The *constructive* may be entered from two avenues, "the first is the skeleton, building up the body gradually, starting "with the skeleton, joints, muscles, &c.; the other avenue is by means "of embryology, beginning with the ovum, and going through the "development of the germinal layers, leading up to various tissues "and organs of the body. In both these courses lectures should be "objective always, and illustrated by means of specimens, diagrams,

* In 1914 at one of the best London Schools, my notes show that there were three subjects in the dissecting room with 15, 16 and 17 students respectively at work on each, which indicates not only a shortage of subjects, but an unsatisfactory arrangement of time. In several medical schools the time devoted to practical anatomy is ill-arranged and insufficiently concentrated.

† In many schools the systematic lectures are still too numerous and inadequately differentiated.

‡ With one or two exceptions only there is no effective provision for study of anatomy in the living body.

§ Co-ordination is the exception rather than the rule.

" models and drawings. The *destructive* way is also twofold, by " demonstration and dissection, the class of practical anatomy being " the most important the medical student takes. It is his first " introduction to original research in a properly equipped department. " The dissecting room is supplied with spare bones, and the teacher " should always be referring to the living model and insisting on the " student realising the relation of the viscera, vessels, &c., to the " surface of the body."

56. Turning from principles to methods, it may be said that there are three means of teaching Anatomy.

(*a*) Introductory and Systematic Lectures.
(*b*) Dissection of the dead body and study of the living body.
(*c*) Demonstrations, elementary and advanced.

Unquestionably, the method of Vesalius, " putting one's own hand to the business," is supreme above all others. The beginner should start to dissect at once; some commence with the trunk, others, which is preferable, with an arm or leg. The whole body should be dissected at least once, the student working out all the structures in the same dissection. Osteology should be taught in the dissecting-room and not only in a bone class.

57. But dissecting alone is insufficient. First, because it concerns the dead body only; secondly, because without proper guidance it lacks its true purpose. The object of studying anatomy is a full and exact knowledge of the form of the *living* body and the co-relations of its organs and parts—not only the form and situation of organs, muscles and other parts, but their purpose and meaning, even the forces at work in their building; all this belongs to the proper study of anatomy. But the position and relation of organs in the dead differ from those in the living; they differ also in greater or less degree according to age and sex; nor is a study of co-ordination and use possible in the dead body, for structure and function are there divorced; there is no "clinical" application, no atmosphere; for the cadaver is out of action, static, dead. Hence the necessity of including in a proper course of Anatomy the continuous and concurrent study of the living body, the model, the child as well as the adult—by means of surface anatomy, the use of X-rays, applied anatomy, and the introduction of clinical cases for demonstration. Further, guidance is necessary, both in the actual work of dissection and by lectures.

58. Didactic instruction takes two forms, the systematic lecture and the demonstration. The ancient practice of delivering a lecture on the theory of anatomy, which was the purpose of the "public anatomie" in vogue from the fourteenth to the sixteenth century, is now largely discarded, and will soon it is hoped entirely disappear. The well-illustrated lecture, or lecture-demonstration, is, however, most valuable if kept in its proper place. In the elementary course its object is *introductory, constructive and synthetic.* It gives the student a general survey of the structure of the body and builds up for him in complete form the various systems, muscular, circulatory, nervous, lymphatic, sympathetic and so on. It unifies and reconstructs the analytical work of his dissection, introduces a measure of deductive reasoning into an inductive course of study, and brings into perspective the large factors affecting morphology, such as embryology, heredity, variation and sex.

It furnishes the occasion for guidance in complex subdivisions of the subject like embryology, where it may be preparatory to a practical class in histology; and it enables the teacher to demonstrate the relation of anatomy to physiology, pathology, medicine and surgery, to physical signs of disease, and to the whole bearing of anatomy on clinical work. It is the opportunity also of teaching the lesson of man's place in Nature and of the co-ordinations and adaptations of the organs of the body. In short, its service is to give the student the "setting," perspective, meaning, or "atmosphere" of Anatomy.* In the advanced courses of anatomy the lecture-demonstration fulfils the duty of guiding the student in his more elaborate studies, and may suitably deal with separate systems of the body, supplementing and co-ordinating the elementary work. In most Medical Schools it has long been the practice to give also a series of demonstrations or tutorial classes in the dissecting room, which form one of the most valuable parts of the course. Throughout the year the body is systematically dissected, and each dissection is fully demonstrated, and this by the study of bones, joints, models, diagrams, blackboard drawings, and sectional dissections. Such demonstrations serve as a link between the analytic and synthetic work.

59. In both lectures and demonstrations arrangements must be made for the introduction of the clinical purpose of anatomy. This may be secured in various ways. The surgical side of anatomy may receive attention by emphasising its relative importance in dissections and demonstrations; the landmarks of the middle line of the neck, the anatomy of inguinal hernia, the relative position of the structures in the popliteal space, the mechanism of the joints of the shoulder, elbow, wrist and knee, the synovial sacs of the palm, the anatomy of the foot, and so on, are all of primary surgical importance, and stand in a wholly different category from certain nerve plexuses, arterial anastomoses, and exact attachments of the large muscles. Another method is to introduce, when practicable, actual clinical cases for demonstration; or surgeons may be appointed as part-time demonstrators in the dissecting room; or, again, students in their fourth or fifth year may be encouraged to return to the anatomical department for special courses of medical or surgical anatomy. Perhaps the best method of all is to introduce into the teaching of clinical subjects the principal anatomical lessons of the case under review as *an integral part of its clinical aspect.*

Equipment and Staff.

60. Though there is no need for an elaborate anatomical department of the proportions of that at Munich, or even separate "institutes" as at Berlin or Würzburg, ample accommodation is absolutely necessary in all cases. There should be, of course, a lecture or demonstration theatre, with epidiascope, lantern, &c.; a light, airy, spacious and well-appointed dissecting-room, with an ample supply of subjects; an anato-

* The number of such lectures differs in different Schools. There are often 50 or 60 in the term. At Manchester, Professor Elliot Smith (1912) gives 30 general lectures in the first year, 100 lectures in the second year on the systems of the body, and 50 advanced lectures in the third year. In the ideal he would prefer to give 30 general lectures and rely for the rest on Dissection and Demonstrations.

mical and anthropological museum containing (*a*) valuable specimens, both rare and normal, which represent research and systematic work, and (*b*) a complete teaching collection; demonstration room with models, dissections, specimens, photographs, &c.; and the usual offices for preservation and preparation. There are substantial advantages in having typical model specimens and dissections in the dissecting room itself for ready reference by the students while at work. The staff should consist of a whole-time professor, whole-time and part-time demonstrators, and necessary assistants and *préparateurs*. In the appointment of demonstrators the requirements of research and of clinical teaching should be borne in mind. Whilst some whole-time demonstrators, adequately remunerated, are necessary, there are advantages in having also on the anatomical staff part-time workers, senior students, investigators and practical surgeons, and for such members of the staff fellowships may well be provided.

The Immediate Needs.

61. The principal need in practically all the schools seems to be a revitalising of the existing methods of teaching anatomy in order that it may respond in adaptation to the needs of the time, and the closer association of the whole of the Anatomy teaching with the other subjects of the curriculum. In all Medical Schools there should be a whole-time professor of anatomy with an adequate salary. His position in the school is a very important one, and his status and remuneration should accord therewith. He should also have a competent and properly paid staff which allows both of effective teaching and of research work. Systematic lectures on the theory of anatomy should be reduced or abolished, and the course made a practical study of high standard, analytic and synthetic. More attention might well be given to histology, embryology, the anatomy of the living body, and the association of anatomy with clinical medicine and surgery. There may be need for some saving of time and labour spent on unnecessary minutiae and unimportant nomenclature. There is certainly need for reform in some of the examinations in anatomy, but for the rest it must be said that the Study of Medicine demands more thorough rather than less thorough treatment of Anatomy, which need not involve an increase in its burden on the student.

SECTION VI.

PHYSIOLOGY.

Introduction.

62. As the name of Vesalius opens the new book of anatomy in the revival of the sixteenth century, so that of Harvey is the inspiration of the rise of modern physiology. Yet, like Vesalius, he built on the labour of his forerunners, and it is essential to a right understanding of physiology that the steps should not be forgotten. Galen and Vesalius had both taught that the blood acquired nutritive properties in the liver, that some of it passed through the septum from the right to the left ventricle, and that air became mixed with the blood in the left ventricle. In 1553 Michael Servetus declared that the blood did not pass through the interventricular septum, but was "transmitted "from the pulmonary artery to the pulmonary vein, by a lengthened "passage through the lungs, in the course of which it is elaborated "and becomes of a crimson colour." Thus became evident the function of the pulmonary artery, the transmission of venous blood through the lungs, and its "preparation" into arterial blood (the lesser or pulmonary circulation), and the lack of communication between the ventricles. Again, in 1571, Caesalpinus of Pisa had grasped the principle that the heart at systole propelled the blood into the aorta and in diastole received the blood from the venous system. Lastly, three years later, Fabricius, the successor of Vesalius in the chair at Padua, described the structure and position of the valves of the veins, though he failed to recognise their purpose. These three men were the forerunners of Harvey, who built on their work and by observation and experiment not only confirmed but rightly interpreted the new knowledge. It is Harvey's fame that he *demonstrated* the circulation of the blood and revealed its issues. It is true that important steps led up to Harvey's work, but vastly more important and far-reaching knowledge sprang from him. He first showed the nature and purpose of the heart beat, its contraction and constriction, its effect on the greater as well as the lesser circulation; he proved that both were essential parts of one circulation, due solely to the heart impulse—"the blood in the "animal's body," he wrote, "is impelled in a circle and is in a state of "ceaseless motion; this is the act or function which the heart performs "by means of its pulse, and it is the sole and only end of the motion "and contraction of the heart." But this was only the beginning, for this discovery led to new conceptions of the whole question of the nutrition of the body by the blood stream, first by throwing light on the function of the blood in its relation to the purpose and properties of the organs of the body, and, secondly, by applying the experimental method it opened the door to a coherent physiology and to a new medicine and surgery.

63. Harvey had studied under Fabricius at Padua, and returned to London in 1602. It was in 1616 that he announced his discovery in the Lumleian Lectures to the College of Physicians, though the *Exercitatio Anatomica De Motu Cordis et Sanguinis in Animalibus* was not published until 1628. From this pregnant source sprang many living streams of new birth. There was, for instance, the inter-relationship between the blood and the lymph associated with

the names of Aselli in 1627 and Pecquet in 1651; there was the influence of the new physics and their effect upon muscular mechanics and the nature of muscular movement worked out by Descartes and Borelli from 1637 to 1680; there was the discovery in 1661 of the capillary circulation by the great Malpighi, who became the first histologist (describing in particular the minute structure of the lung), and who by means of the microscope carried on and continued Harvey's work, as perhaps no other man was able to do, in the realm of biology, embryology and pathology; then during some twenty years from 1643 to 1662 a series of investigations added to our knowledge of the secreting glands and their ducts, the pancreas (Wirsung), the submaxillary (Wharton), the parotid (Stensen), the kidney (Bellini), and the liver (Glisson), culminating in Malpighi's study of the viscera; there was the school of English physiologists who followed in the footsteps of Harvey and began the study of the physiology of the respiration (Willis, Boyle, Hooke, Lower and Mayow) and so prepared the way for Hales, for Black, Priestley and Lavoisier in the eighteenth century; lastly, the foundations were laid by Van Helmont and Haller of that clinical physiology which to-day forms so large a part of our understanding of the working of the body. This wonderful chapter followed directly from Harvey's discoveries or from the application of his methods, and the lesson to be learned is full of instruction to those who would design a scheme of physiological teaching.

64. The lesson is fourfold. First, the broad truth emerges that no man wholly begins, and certainly none wholly completes, his contribution. Each is a link in the chain; one sure step in study or in research leads to another. Then more important is the fact that we are witnesses of a passage from tradition as authority to observation and experiment as authority, as the one and only sound means and criterion of the scientific method. "Harvey's work," said Sir Michael Foster, "was a "shining example for all future inquirers. The patient examination "of anatomical features, if possible a comparison of those features in "the same organ or part in more animals than one, the laying hold "of some explanation of the purpose of those features suggested by "the features themselves, and the devising of experiments, which "should test the validity of that explanation—that was Harvey's "threefold method." Thirdly, all through these researches for two hundred years we see the relation of comparative anatomy to human physiology, and the building up of the modern science of physiology from its constituent parts of anatomy, histology, experimental physiology and chemistry. It is certain that the new anatomy of the sixteenth century became the basis of the physiology of the seventeenth and eighteenth; and both together, as coherent parts of a comprehensive knowledge of the human body, formed the sure foundation of their application to disease in the nineteenth century. Lastly, there has been the steady emergence of the sense of *function* as the predominant factor in the body autonomy. Thus has been created the structure of our existing scheme of physiological education.

Content of the Subject.

65. The subject of Physiology in this country usually comprises general physiology, histology and chemical physiology; and its study in most Medical Schools includes systematic lectures, practical or

"observational" work in the laboratory, and special demonstrations. On the whole probably the teaching of this subject has received more and wiser attention in England than any other of the subjects of the medical curriculum. The departments and teachers are alike well equipped, and as a result the educational position of Physiology in this country compares favourably with that now obtaining in other countries. Yet both in content and in form of instruction substantial changes are proceeding. Every year physiology becomes more intricate and the search for ultimate causes, factors and inter-relations becomes more complex. Hence has arisen a tendency for the teaching of the subject to fly off at unexpected tangents, now a tendency in favour of muscle nerve mechanism holds sway, now an enthusiasm for chemical physiology. Sometimes these changes are reflected in the normal curriculum, which differs within restricted limitations in different Medical Schools according to the predilection, skill or experience of the professor; at other times, as in Germany and America, it leads to an increase in the number and character of the optional or "elective" courses associated with Physiology. For instance, at Harvard in addition to the ordinary course a student may take comparative physiology, bio-chemistry, or advanced physiology of the special senses, and at Johns Hopkins there are subdivisions with special instructors in advanced physiology, physiological chemistry, neurology, embryology, and so on. In this country, too, the principal physiological departments at Oxford, University College, London, and Cambridge make similar provision. At Guy's Hospital optional subjects include the physiology of the skin and secretion; at the London Hospital, the senses; and at St. Thomas's, blood and muscle.

66. The practical or observational work in physiology is usually subdivided into three parts: (i) experimental physiology; (ii) chemical physiology; and (iii) histology. In all Medical Schools the ground covered is now approximately the same, though the manner of proceeding differs and the emphasis laid upon different parts of the course varies. Thirty years ago the practical physiology lesson was one in histology; then came the period of the muscle-nerve experiment; lastly, there followed the subject of chemical physiology. In this country it is probably correct to say that too much emphasis was laid upon the intermediate stage, and even now in some Schools undue attention is paid to muscle-nerve preparation and recording. Speaking generally, the modern advance of physiology is now fairly represented in the practical course, namely, the observation and if need be experimentation, which discloses the functioning of the living organism as a whole, one organ reacting on another, but all working as a unity and not as a mere assemblage of separate though commensal organs and tissues. The practical course is related to the lecture course and either accompanies it or follows it.

Experimental Physiology includes practice with an induction coil and other electrical apparatus and the graphic method; the nature of living matter, muscle and nerve, properties, stimulation and reactions, contraction, tetanus, with effects of load, fatigue, temperature, chemical standards, &c.; polar stimulation work; reflex and automatic action; vago-sympathetics; heart and heart beat, blood vessels, circulation and blood pressure; inhibition, cardiograph, sphygmograph and stethoscope; pulse-tracings; respiration, air and gas analysis; digestion, excretion,

secretion; functions of nervous system; sensation (touch, taste, smell, vision, hearing).

Chemical Physiology includes the chemistry of the carbohydrates, proteins and fats; chemical analysis of tissues and fluids of the body (blood, milk, muscle, gastric juice, adipose tissue, bile, &c.); digestive processes (salivary, gastric, pancreatic, biliary), urine, excretion; secretion, fermentation, metabolism; physico-chemistry.

Histology includes the cytology of the blood; epithelium, connective tissue, cartilage, bone, muscle and nerve, heart, arteries, veins, lymph vessels, ductless glands, skin, trachea, bronchi, lung, tooth, tongue, salivary glands, œsophagus, stomach, intestine, liver, pancreas, urinary and reproductive organs, central nervous system, eye, nose, ear.

67. These main subjects dealt with are common to all the best medical courses in Great Britain and America, and constitute a common denominator of practical physiology. In some Schools they are elaborated both in content and presentation. For instance, the student's experimental work reaches an exceptionally high standard under Professor Howell at Johns Hopkins University, Baltimore, and in the University of Pennsylvania. The former is ahead of anything else of its kind in the States, and in England is reached by only a few of the best Schools. The ground covered is similar to that in England, but the subject is dealt with more thoroughly and systematically. The student works as far as may be on living tissues, and many of the observations are made on the human "model."

It is the usual practice to provide the student with the necessary apparatus, materials, specimens and reagents, and to give him in printed form, as syllabus, directions as to procedure. Then two somewhat dissimilar courses are adopted. In the first, which is the commoner, the student is told what he is to observe, the facts of the case before him, and the results which he is to secure; in the second he is instructed to observe, to describe what he sees, and to draw his own deductions. In his introduction to the Practical Course in the University of Glasgow, Professor Noel Paton sets out the educational advantages of this second method:—

> "The objects of this Course are twofold," he writes, "first, to train the student in the investigation of the many problems of medical science which he has afterwards to face, and to teach him to observe, record, and describe the vital phenomena with which he has to deal. Second, to give him a real and sound practical foundation to his after study of Physiology, based upon his personal experience and not upon the dicta of his teacher and text books.
>
> "For this reason the problems to be investigated and the method of investigation are indicated, but the results to be obtained and the conclusions to be drawn are left to the student, who must before all be taught to observe and to experiment without preconceived ideas and without any anticipation of a particular result, but with a mind open to accept whatever result may be obtained, and from that result to attempt the solution of the problem under investigation.
>
> "Before beginning any experiment the student must first clearly understand its *object*, and no student will be allowed to continue an experiment who has not entered in his note book the question to be investigated. He must also before starting understand the *method* adopted and how it will throw light upon the question. While carrying out the experiment he must not confine his attention to the main *result*, but must observe everything which happens and record for further investigation anything he does not understand. . . . *From the results obtained* an attempt must be made to draw *conclusions* and to give an answer to the question which is under investigation."

By this method, then, the student is taught in every experiment to be a research worker, to record the objects, method, results and conclusions of his investigation, to build up his knowledge himself by inductive processes, to advance in his study from the simple to the complex, and to lay foundations for a synthetic understanding of the physiology of man. To this ultimate issue we must now turn.

The Application to Mammalian and Human Physiology.

68. It will be instructive to consider the course at Oxford as typical of the best kind of synthetic physiological teaching now practised in England. There are 50 systematic lectures covering the usual ground of General Physiology accompanied by a junior and senior practical course, the former following the usual lines of work already described in chemical physiology, experimental physiology and histology; the latter or advanced course consisting of twenty exercises, comprising 60 separate experiments, in mammalian physiology on the carcase of the Cat. Professor Sherrington kindly allows me to include the outline of these exercises, which I mention here as an illustration of the kind of Applied Physiology (serving partly as a basis of pharmacology) which should in my view be taught in all schools of physiology:—

SYLLABUS OF ARRANGEMENT OF COURSE.

Exercise I.—Segmentation movements and tonus of excised intestine; influence of temperature and of adrenalin. Influence of adrenalin on spleen and arterial wall (aorta).

Exercise II.—Revival and beat of excised mammalian heart; influence of temperature upon; cooling and warming of the "pace-maker."

Exercise III.—Influence of adrenalin and chloroform upon the beating of the excised mammalian heart.

Exercise IV.—Inspection and examination of the beating heart *in situ*; its relation to the inspiratory and expiratory positions of the lungs; pericardial effusion experiment; colour and tension of chambers of heart, of aorta, pulmonary artery and veins, and venæ cavæ; influence of vagus on heart, diaphragm and stimulation of phrenic nerve. Microscope examination of capillary flow.

Exercise V.—Arterial-pressure, kymograph record; influence of vagus upon; paralysis of the cardiac vagus by atropine; effect of stimulation of the spinal cord on external pressure.

Exercise VI.—Arterial-pressure record by the kymograph; influence of (1) intravenous injection of adrenalin, (2) of asphyxia, and (3) of amyl-nitrite; observation of venous pressure; occlusion of coronary vessels and "delirium cordis."

Exercise VII.—Stimulation of the splanchnic nerve on arterial pressure, before and after removal of the adrenal gland; pituitrin effect on arterial pressure. Time of the lesser circulation. Inspection of the lacteals.

Exercise VIII.—Production of aortic-valve incompetence and effect on arterial pressure and pulse. Tissue respiration by the methylene blue experiment.

Exercise IX.—Stimulation of the cardio-accelerator nerves. Inspection of the glottis. Stimulation of recurrent laryngeal and effect on the vocal cords.

Exercise X.—Diuresis. Influence of intravenous injection of saline fluids upon urinary secretion; diuretic effect of pituitrin.

Exercise XI.—The specific gravity of the blood; effect of intravenous injection of saline and of hæmorrhage. Hæmolysis. Perfusion of kidney and influence of pituitrin on the renal blood vessels.

Exercise XII.—Salivary secretion; secretory action of the chorda tympani upon the submaxillary and sublingual glands; influence of atropine, and of pilocarpine. Air-embolism. Aspiratory expansion of the lungs, and pneumothorax.

Exercise XIII.—Reflex swallowing; phagetic power of water, oil and alcohol (20 per cent.) compared. Inspection of the respiratory movements of the glottis. The bulbar respiratory centre. Respiratory movements of the chest and abdomen. Influence of swallowing upon them; influence of the vagus upon them.

Exercise XIV.—The depressor nerve. Pressor and Depressor Reflexes on the arterial pressure, kymograph record.

Exercise XV.—Vasomotor action of the cervical sympathetic. Effect of hæmorrhage on arterial pressure; restorative influence of intravenous injection of saline-gum fluild. Preparation of blood-plasma and of blood serum, the leucocyte layer. Retarding of clotting by decalcification; preparations of fibrinogen and serum globulin compared.

Exercise XVI.—Law of conduction of the spinal nerve roots (Magendie's experiment).

Exercise XVII.—The knee-jerk; the scratch-reflex; the pinna-reflex and illustration by it of the law of conduction of the spinal roots.

Exercise XVIII.—Reflexes of flexor muscle; proprioceptive reflex of tibialis anticus; comparison of reflex with peripheral contraction.

Exercise XIX.—Reflexes of an extensor muscle; reflex postural action of; reflex inhibitory relaxation.

Exercise XX.—Phagocytosis by blood leucocytes; opsonins.

The sequence of arrangement of the successive exercises at Oxford is one which has been found appropriate; but it is, of course, open to modification without impairment of the efficiency of the course. As arranged, the exercises on organs isolated from the body in a surviving state are taken first; then those on the circulation, commencing with the Harvey observations; then those on respiration and the central nervous system; and finally the experiment on phagocytosis and the opsonin action of serum. This last, and that illustrating the after treatment of hæmorrhage by transfusion, of gum-saline, are placed late as bordering on pathology which the student will next pursue after his physiological course is finished. In conducting this admirable course typed directions explaining the steps of the various experiments included under each exercise are issued to the students for each lesson.

69. Such a mammalian course possesses some substantial advantages. It is a valuable experience in technique which the student cannot otherwise obtain; it leads his mind away from the frog to the higher types, and he is able to apply his previous work on the frog;* it extends the scope of animal physiology to a position which approximates to that of man; it interprets for the student the meaning of the fundamental experiments of the great masters of physiology; and

* From the days of Malpighi the frog has been used as a type for physiological demonstration. He used it to discover the capilliary system of the lung. Swammerdam and Leuwenhoek worked on the corpuscles of the frog's blood; Galvani discovered "animal electricity" in its leg muscles; Stannius and Weber experimented on its heart, Müller on its spinal cord, Helmholtz on its sciatic nerve, Waller on its tongue papillæ, the emigration of its leucocytes, and the degeneration and regeneration of its nerve fibres, Lister on its pigment cells and vasomotor nerves; and all experimental physiologists have worked on muscle nerve preparations from the frog.

it prepares him for the application of his subject to clinical work. This indeed is the supreme issue in all true physiological teaching, it must unfold and make manifest the "regulation" of the human body.* It would be well if in every medical school some practical "exercises" could be undertaken by each student in the Physiology of the Living Man, for only thus can the close and necessary association between physiology and clinical work be obtained. By way of example the following suggestions may be worthy of consideration, and from such applications it is but a step to the clinical physiology of the bedside:—

A. *Heart and Circulation*—

(i) Normal Heart-Sounds—and the direction of their conduction. Where are the aortic and mitral sounds best heard, and why? What are the modifications in relation to respiration, and before and after exercise?

(ii) Arterial blood-pressure: measure in man, *e.g.*, by Riva-Rocci's sphygmomanometer (maximum and minimum with variations under differing respiration of degree and rate).

(iii) Venous blood-pressure.

(iv) Pulse-curve: sphygmographic tracings (cardiograms and carotid pulse, &c.).

(v) Alteration of pulse rate by spell of exercise (*e.g.*, stepping on to chair five times in 15 seconds; period required for return to normal).

(vi) Electric current from heart-beat by galvanometer (basis of the modern electro-cardiograph method).

(vii) Blood-counting (Oliver's hæmatocytometer).

(viii) The use of the hæmoglobinometer.

B. *Respiration*—

(i) Breath sounds: frequency, character, position, &c.

(ii) Old "vital capacity" observation (Hutchinson)—lately revived as useful for various functional cases in military hospitals and camps.

(iii) Period for which breath can be held (tests alveolar ventilation) before and after spell of exercise (*e.g.*, after stepping on chair five times in 15 seconds). Cheyne-Stokes respiration.

(iv) Expiratory force—should support 105 m.m. Hg. (found useful test at Air Board examination).

C. *Clinical Thermometer*: mode of use, and fallacies, variations in temperature according to position.

D. *Muscular system*—

(i) Law of contraction to electric stimulation on muscle of forearm.

(ii) Electrical stimulation of motor points.

(iii) Knee-jerk and other forms of reflex.

(iv) Muscle fatigue by ergograph and other methods.

E. *Senses*—

(i) Skin: area examined as in clinique—

(*a*) *e.g.*, *touch* by bristle æsthesiometer—"touch-spots" ascertained and marked—

cold—by cold test-tube.
warm—by warm test-tube.
pain—by algesimeter.
deep-touch—in cocainised area.

(*b*) Compass tests for spatial discrimination.

* *Organism and Environment*, by J. S. Haldane, M.D., F.R.S., 1917.

(ii) *Muscle-sense*—

e.g., by balancing rod on planchette with closed eyes—observing what kind and degree of error.

(iii) *Labyrinth*—

(*a*) Rotatory chair, with vertigo and mystagmus reflexes, and errors in muscular co-ordination produced thereby.

(*b*) Hearing tests—intensity of sound and distance.

(iv) *Eye*—

(*a*) Visual field—by perimeter, blindspot, focal delimitations, and charts of visual field for each eye for different colour sensations.

(*b*) Visual acuity (Snellen's tests).

(*c*) Simple opthalmoscope (now readily available because electric lamp ophthalmoscope available for beginners).

(*d*) Determination of near-point.

(*e*) Contraction of pupil to light—consensual in man.

(*f*) Squint produced by prism in interest of binocular vision of image right and left.

(*g*) Examination of chromatic aberration of the normal eyeball.

(*h*) Binocular vision and the third dimension—stereoscope.

(*i*) Tests for colour vision and colour fusion, uniocular and binocular.

(*j*) The principles of the ophthalmometer.

F. *Methods of testing functional integrity of the various organs of the body*: lungs, heart, liver, kidneys, nervous system, &c.

Along such lines as these progress should now be made, for it is by these means that physiology is brought into contact with clinical conditions; and, as in Anatomy, the sound direction of advance is not to bring the patient to the Physiological Department, but to take physiology to the hospital. "English physiology," said Mr. Flexner, "has not yet conquered English medicine;" if that indeed be the case, it can only be added that it is in a fair way to do so, owing to the labours in our own day of Michael Foster, Hughlings Jackson, Ferrier, Head, Sherrington and Starling.

Conclusion.

70. Speaking generally, it is agreed among physiologists that their subject can be properly taught only by practice, in personal observation and experiment, and that it should be undertaken in the three subdivisions—general experimental physiology, histology, and chemical physiology.* The method, technique and apparatus furnished to the student is now likewise much the same in all efficient English and American laboratories, though some are better equipped in this respect than others. In order, however, to avoid a wooden and mechanical application it is evidently necessary to bear in mind some general principles which should govern such laboratory work. (i) First and foremost, the organic inter-relation between general physiology, histology and chemical physiology must be borne in mind. At present there is, here as elsewhere, too great a tendency to work in

* It is open to question whether histology should be retained under Physiology. As we have seen, there are advantages in placing it under Anatomy. But wherever it is included it must be taught as a living and changing factor and not as a dead mosaic, and its relation to physico-chemical activities must be borne in mind.

water-tight compartments, yet the relationship of structure and chemical property with function and life is obvious. The essential feature is the emergence of function and life. (ii) Secondly, the several parts of the practical course must be held in due proportion, emphasis being laid less upon traditional muscle-nerve preparation and experiment and more upon the physiology of the heart and circulation, of secretion, of digestion, and above all of organic regulation. The devotion of excess of time and attention to muscle tracings is to be deprecated. The vitals of physiology lie elsewhere. Function is something much more complex than mechanics. It involves not only the performance of a duty by specialised cells, tissues or organs, but an organic control of structure and office, and of one system by another. The function of respiration implies not only respiratory mechanism but chemical change also, and both fall under the control of the nervous system. It is idle to teach the student of respiration, digestion or secretion without a full recognition of this axiom. (iii) In the third place, the student should apply his observations and experiments on the frog to mammals, and where practicable to man himself or his fellow students, making his work bear as directly as possible on the living body. (iv) Fourthly, much is lost by the practical divorce of physiological teaching from pathology and clinical medicine and surgery, partly owing to the student discarding his physiology when he has passed his intermediate examination. Arrangements should be made for a much closer association of the physiological department in the University with the pharmacological and pathological laboratories, and even the ward work of the hospital; and this might well be secured by dovetailing with the clinical subjects instruction in Applied Physiology, as may be found most suitable in each school. (v) Lastly, not only should the practical course in physiology be concurrent with the systematic teaching of the subject, but it should depend upon the personal work of each student, his own observation and his own experiment; for thus only can we introduce the true practice of research, of which alone the living spirit of physiology is born. The clinician must be ever a physiologist, the physiologist always a researcher.

71. It is obvious that to carry out these ideals in practice means some re-arrangement in many Medical Schools. It means more equipment, better teaching, and a new relation of the teaching of this subject to pathology and anatomy on the one hand, and to clinical work on the other. And all this means expense, but it is expenditure which should be incurred. The immediate necessities in regard to this subject in the Medical Schools are (*a*) a reduction of systematic lectures and a larger understanding of the methods and purposes of practical work; (*b*) more thorough guidance as to the relative importance of the issues raised in the practical class; (*c*) a closer association of physiology with the other intermediate subjects and with the clinical work; and (*d*) increased facilities for research.

SECTION VII.

PHARMACOLOGY AND THERAPEUTICS.

72. "I must confess that, if I had my way, I should abolish it altogether," said Huxley in 1870 referring to the old-fashioned way of teaching pharmacy and materia medica. The elapse of 48 years has done something to confirm the sound commonsense of this advice. Twenty-five years ago two famous courses of didactic lectures were in current delivery to medical students in this country, one at Edinburgh by Sir Thomas Fraser, the other at St. Bartholomew's by Sir Lauder Brunton. The former consisted of a hundred lectures on the principal drugs of the Pharmacopœia, their pharmaceutical characters, pharmacological action and therapeutic use. It was a comprehensive, grand inventory of the whole range of pharmaceutical agents. The course concluded with half-a-dozen lectures on dietetics. For practical work there was "pharmacognosy," manipulative pharmacy and prescription writing and dispensing. Sir Lauder Brunton's course, on the same subject at the same time, had a different centre of gravity, for it was based upon the action of the drug upon the body. The lectures contained relatively little information concerning the pharmaceutical properties of the drugs, but they were full to overflowing of purpose, and full too of physiology, pathology and clinical wisdom. "Their use," said their author, "is not to supply the student with all the "information he needs, but to awaken his attention, to excite his "interest, to impress upon him certain points which will form a "nucleus for his knowledge, and around which he may afterwards "group more information." Since that time these two typical methods have been followed in many parts of the world. Yet neither of them meets the real problem raised by this difficult but extremely important subject of the principles and practice of treatment. "The starting point of all treatment," said Sir William Osler, "is the knowledge of the natural history of disease." And during the last 25 years our knowledge of the nature of disease has been profoundly changed. Moreover, we have now at hand a new pharmacy, a pharmacy not remote from the living body cells and fluids themselves, a *vis medicatrix naturæ* of which the early pharmacologists scarcely dreamed. Nor are these the only changes which have occurred. There has been a vast development in the commercial preparation of drugs and the dispensing of chemists, which has made obsolete some of the old-fashioned drug preparations of the private practitioner. In Scotland probably the majority of practitioners have ceased to dispense; in England and Wales on the other hand two-thirds of the practitioners usually make up their prescriptions, or at least a proportion of them. But the centre of gravity is moving its position. Lectures on materia medica and exercises in prescription writing and pharmacy are therefore not sufficient. What is required is—

(*a*) a practical knowledge of the effects of drugs on animals and on the human body in health and disease—a problem of pharmacology in the laboratory;

(*b*) the action of drugs in disease, pathologically and clinically—a problem of the art of therapeutics in the hospital (often by team work in conjunction with (*a*));

(*c*) standardisation of drugs—a problem in scientific pharmacy.

But they each overlap indefinitely.

73. The subject has hitherto been subdivided into Materia Medica, Pharmacology, Pharmacy and Therapeutics. The materia medica is now found recorded in the British Pharmacopœia and their properties described in the text books. To discourse upon them becomes therefore a task of supererogation. Pharmacy for the medical student is also, as we have seen, now less necessary than formerly. There remain the two central branches of the subject—pharmacology and therapeutics. And it must be said that with one or two exceptions both subjects are neglected throughout the English medical schools. First, they are neglected in themselves. There is only one complete pharmacological institute in London, that at University College, opened under the direction of Professor Cushny in 1912; there are not half-a-dozen full-time teachers of the subject in the whole country; there is little attempt to provide an adequate practical training and in most schools the students themselves undertake no experimental work; the part-time instruction is somewhat perfunctory and research, as part of the work of the medical school, is fragmentary. In the second place, where pharmacology is being taught, there is often a failure to demonstrate its relation to physiology and pathology. Yet a moment's reflection will show its inter-relativity. Botany and chemistry provided the crude drug since the days of the herbalists and alchemists; chemistry revealed its active principles; physiology prescribed the conditions for the observation of its effects; pharmacology and chemistry tested its action by experiment on the normal animal; pharmacy and chemistry prepared the drug for medicinal dispensing; materia medica described its use and properties; finally, therapeutics proved by experience its action on the human body in disease. "Practical medicine," said Sir Lauder Brunton, "depends on physiology, "pharmacology and pathology, but all three are tending to become "more and more subdivisions of the wider and all-embracing science "of chemistry." Lastly, and most serious of all, there is great lack of teaching in therapeutics. Following the example set 50 years ago pharmacologists have dwelt apart from the practice of medicine. Even at University College the Pharmacological Institute is wholly dissociated from the hospital, and in no medical school in England is sufficient attention being given to the systematic instruction of students in the effects of medicinal treatment. The case is diagnosed and its treatment prescribed, but such treatment is but rarely closely observed or assessed by the student.

74. Indeed, in some hospitals the task of prescribing and dispensing, sometimes even the determination of the drugs to be used, is undertaken by the pharmaceutist to the hospital on the basis of the hospital pharmacopœia (for the preparation of which the pharmaceutist is responsible). There is little or no accurate observation or record of the result, inquiry by the physician or student being confined to general features, assumptions, or the subjective symptoms of the patient. Not infrequently the student is actually unaware of the medicinal treatment to which the patient is subject. Would it not be

well that he should know what drug is being used? and why? and how much, and when, and how often? and in what form, and with what vehicle? and under what conditions, and with what relation to food or drink or sleep? And should the student not study exactly what are the results of the drug, general and specific? And upon what organs and under what conditions, and whether immediate or remote? Digitalis, for instance, exerts effects on the heart, which include direct influences on the cardiac muscle and indirect through the inhibitory apparatus (the vagus centre in the medulla, the inhibitory ganglia at the base of the heart, or the vagus nerve endings in the cardiac muscle), and like other drugs its effect is quantitative as well as qualitative, and it may be accompanied by unpleasant and even injurious action (irregularity of pulse, diminution of urinary secretion, nausea and sickness). Is the student encouraged to study all these points and in a large number of cases? and to consider also what other factors are affecting the patient as well as the digitalis? He is told about these things, but does he study them clinically? is he a *doer* of the word or only a hearer? "The absence of accurate clinical records," wrote Professor Cushny in 1910, "such as we can use to substantiate "our laboratory findings, is seriously hindering the advance of "therapeutics."

75. Speaking generally, the teaching of this subject, therefore, calls for reconsideration and reorganisation. It should be divided into the two branches, pharmacology and therapeutics, which should not, however, be separated from each other. Materia medica can well be substantially reduced, and pharmacy can be unloaded. Pharmacology should deal (*a*) with the principles and rational practice of drug action, its effect and the explanation of its effect, and (*b*) the careful and thorough study of the principal drugs now in therapeutic use in health and disease. There should be systematic instruction dealing with (*a*) absorption and excretion, (*b*) dosage, dosage factors, synergism and antagonism, (*c*) stimulants, convulsants, narcotics, depressants, (*d*) muscle and nerve, (*e*) peripheral nerves, (*f*) cardiac agents, (*g*) blood pressure and respiration, (*h*) blood pressure and the heart, (*i*) diuresis and peristalsis, (*j*) perfusion, (*k*) anæsthesia, (*l*) vaccine therapy and serum therapy, and so forth; and there should be practical classes studying in the laboratory the character and effects of the principal drugs, their composition, physical characters, appearance, odour, taste, solubility, incompatibility, methods of administration, dosage and physiological action. There is no need to burden such work with an endless array from the whole Pharmacopœia; 40 to 50 drugs will be ample, including detailed study of ether and chloroform, digitalis, mercury, the iodides and bromides, the alkalis, purgatives, cinchona, aconite, nitrates, salicylates, strychnine, alcohol, arsenic, opium, belladonna, and atropine, cocaine, strophanthus, ergot, iron and bismuth, and their exact action on the body. In the best of the American schools, the practical class studies the action of drugs on the different systems seriatim. "I feel certain," says Professor Abel, of Johns Hopkins, "that no "practical course in the entire medical curriculum can be made "more valuable both from a scientific and a practical point of view "than a practical course in pharmacology."

76. In Therapeutics too there should be systematic instruction in the principles and practice of rational treatment as well as clinical and

pathological study. Pharmaceutical and non-pharmaceutical treatment should be observed in the ward-patient and the out-patient. The effect of drugs properly and continuously estimated from day to day should be accompanied by an equally careful study of the Therapeutics of dietetics, rest, hygiene, hydrotherapy, electric treatment, Finsen light, X-rays and radiotherapy, remedial gymnastics, thermotherapy, climatology, high altitudes, open air, massage, psychotherapy—and there is that whole new group of therapeutic agents, vaccines, antitoxic serums, thyroid extract, and salvarsan. How many students before the war had any insight into the new sphere of medicine opened up in the prophylaxis of tubercle, typhoid, or streptococcal infection, of the serumtherapy of diphtheria, tetanus, dysentery or meningitis? Yet here alone within compass of a few months has been one of the indubitable conquests of science undreamt of half a generation ago. How many medical students in the last three years have been instructed in the new application of medicine as practised in the great military hospitals, camps and centres, in wound treatment, orthopædics, hydrotherapy, electrotherapy, remedial exercises, serum therapy, neurotherapy, psychotherapy? Yet these form the very vanguard of modern therapeutics.

77. The question naturally arises: How is the practical teaching of therapeutics best conducted for the medical student? In England it is insufficiently organised unless under somewhat rare and exceptional conditions. But in certain schools in America, *e.g.*, Columbia, Bellevue, Johns Hopkins, Pennsylvania, Yale, and Toronto, it is admirably arranged in what are described as "therapeutic clinics," where the student himself witnesses and gauges the direct application to the patient and the actual results of such treatment. There are medical clinics charged with the responsibility of emphasising the therapeutic problems of disease. The advantages are substantial. The student observes the effect of the drug on the patient and keeps a card record of the objects and results of treatment day by day; the therapeutic use of the drug rather than its pharmaceutical character becomes the point at issue; the system of the body and not the laboratory only is the sphere of action. Thus a new understanding of classification is founded on therapeutic use. At the Bellevue Hospital School in New York the lecture course and the accompanying therapeutic clinic afford opportunity for a comprehensive handling of the subject: (1) to review briefly the physiology of the system under consideration, cardiac, respiratory, alimentary, and nervous; (2) to review comparatively the drugs and forms of treatment acting on the tract; (3) to discuss the pathology of the case and the precise purpose of treatment; (4) to review the relative value of the means as accomplishing the object. All this means that pharmacology is tested in the laboratory and proved in the hospital. "I am particularly interested "in the efforts to co-ordinate the laboratory and the clinical teaching," wrote Professor Cushny in 1909, "as I am convinced that nothing is so "much required at present as to bring scientific therapeutics in touch "with laboratory results. The weakest point in our subject is the actual "bed-side end of it, and we need accurate and detailed examination of "the results of drugs on patients. As far as the laboratory work is "concerned, we are ahead of the clinical application. Whether the "laboratory worker should himself go to the clinic is another question.

" It is much preferable if he can inspire the internist to take an " intelligent interest in the subject, and not be content merely to make " a diagnosis. But the methods of the examination of the effects " should of course be carried out as carefully at the bed-side as in the " laboratory; and here is the point where I find difficulty. The " internist is so liable to determine the efficiency of a drug by " statistics of cures, which is of course a very fallacious method for " most purposes."

78. There would seem to be three alternative ways of strengthening the teaching of clinical medicine on its therapeutic side. First, there may be a professor of pharmacology, with beds—an arrangement which has some serious disadvantages; secondly, there may be a whole-time professor of pharmacology, without beds, and a whole-time professor of therapeutics, with beds, both adequately remunerated and working in close co-operation—and this is perhaps the ideal arrangement; or, thirdly, the whole-time professor of pharmacology (without beds) may have an assistant pharmacologist for laboratory work and an assistant physician, with beds, for hospital and clinical work, both for fixed periods. By one or other of these methods, and by systematic attention to the whole subject of teaching pharmacology, we can obtain the desideratum, the expansion of our knowledge and the direct, scientific, and effectual study and application of therapeutics to the diseases of man.

SECTION VIII.

PATHOLOGY.

79. The study of pathology includes morbid anatomy and histology, general, special, clinical and chemical pathology, and bacteriology. It is associated with anatomy in respect of abnormal structure, with physiology as perverted function, and with the clinical subjects in regard to the resultant disease. Morgagni and Virchow were the first of modern pathologists to demonstrate this comprehensiveness of the subject as they were the first to lay emphasis on the process of disease. For disease is a process and not a fixed entity. It has, as Virchow said, a local focus and a local origin. It may affect the whole body or more commonly an organ or tissue. But it begins in the *cell*. In the modern understanding all pathology is cellular pathology, which may or may not issue in recognisable disease from a clinical standpoint. Indeed, we are beginning to get further back still to the physico-chemical changes taking place within the cell. Pathology is the study of this process, and the autopsy is the final step in the elucidation of the clinical problem. Thus it is that pathology is inter-related with physics and chemistry, with anatomy and physiology, with clinical study and post-mortem examination; and the object is to determine the cause and conditions of disease, to define and explain the morbid state, and above all to interpret its process and meaning in the living patient.

In the narrow study of disease, therefore, there must be the necropsy —the observation of the diseased organ and tissue, dead; but there must also be the clinical case—the observation of disease in the living man. For this observation two requirements are necessary, ample laboratory provision intimately associated with the hospital. And as Virchow taught, the pathologist engaged either in laboratory or hospital must be both "pathological anatomist" and "pathological physiologist." Two typical methods of working out these ideals are common, one German, the other English.

The Pathological Institute.

80. The characteristic institution concerned in the German method of teaching pathology is the "pathological institute." It is established on the principle that the necropsy is the corner-stone of the subject, and it is, in fact, the transformation of the dead-house into a university institute, under the direction of the professor of pathology. The institute thus becomes the centre of procedure in pathological instruction. But it is not thereby isolated either from the intermediate subjects on the one hand or the clinical subjects on the other. When Virchow returned to Berlin in 1856 from Wurzburg, he stipulated that he should be provided with an ample and well-planned pathological institute *attached to the Charité Hospital*. Forty years later that same vital relationship was made concrete in the case of the new pathological institute at Glasgow, which was also associated both with the hospital (the Western Infirmary) and with the University. It is important to appreciate the fact that this principle of Virchow makes the professor of pathology both director of the University institute and pathologist to

the hospital. Thus the German institute is initiated wisely. But its whole organisation is also instructive. The pathological institutes at Berlin, Munich, and Wurzburg all conform to the same type. The central feature of the building is an autopsy room (with necessary receiving rooms for the dead), well fitted and equipped with ample classroom accommodation for students; adjoining are laboratories for morbid anatomy, histological work and photography, for anatomical, bacteriological and chemical research; a museum of typical specimens and a library. The director is assisted by a staff of experts in the various branches of pathology, working under whom may be selected students. The whole establishment is closely associated with the hospital which it adjoins or on the premises of which it is situated. In some universities the director is also in control of a number of beds. Thus the institute stands well equipped and ready at the very centre of the hospital autonomy, and at the centre, too, of the teaching of pathology, for it is here that the student receives his training, such as it is, in this subject. In many cases the systematic lectures are reduced to introductory discourses on the principles of pathology, and for the rest the student learns from the demonstration of the fresh specimens and the new autopsy. The current autopsy rather than systematic conceptions constitutes the theme presented. This method has its peculiar disadvantages, but it is mentioned here to illustrate the unity of idea for which it stands. The autopsy is the centre of gravity of the whole scheme; the association of pathology with the hospital on the one hand, and with the intermediate subjects on the other, represents substantial gains.

81. In England the post-mortem room is at the hospital, and so originally was the medical school. But partly owing to various social conditions, and partly owing to hospital administrative arrangements, the full advantage of pathological research was not as a rule formerly obtainable, with the result that, with a few remarkable exceptions, the teaching of the subject did not evolve much further than the performance of autopsy for verification purposes and the creation of a museum of morbid specimens. Occasionally the more zealous student had a share in the post mortem work or there was a demonstration of specimens, but the exposition of the subject was limited. "Pathology, "as distinguished from practical medicine," said Sir James Paget in 1887, "used to be regarded as scarcely more than morbid anatomy; "but now there is in it work not only for the anatomist and physiolo- "gist but for the clinical observer, the experimentalist, the micro- "scopist, the statistician, the chemist, the naturalist, the historian, the "psychologist, and yet more. It is certain that complete pathology "must be constructed from the works of all these; they are naturally "dependent, mutually corrective, none can alone suffice, and none can "safely be neglected."* The English medical schools at first made but little headway in the direction indicated in these words. In London twenty-five years ago the hospital staff as a rule undertook the autopsies, though specialists were appointed when the amount of work was exceptionally large; in the provinces and at Edinburgh further differentiation was attempted, but the subject remained what may not unfairly be described as "dead-house and museum pathology."

* "Life and Letters of Sir James Paget," p. 365.

Present Methods of Teaching Pathology.

82. Then came the modern advance in pathological methods and in bacteriology, and the establishment of various provincial medical schools. The result was some reconstruction of the teaching of the subject, which fostered the physiological study of pathological processes, which encouraged scientific research, and which brought the subject into closer association with clinical work. The instruction of the student in the post-mortem room was also organised and made an integral part of his training. In Glasgow there was founded a "pathological institute"; in London the institution of the pathological laboratories of the Royal Colleges was followed by the Lister Institute; in Edinburgh the College of Physicians established a research institute.* The methods of teaching in the best schools have also undergone great improvement in recent years. At Edinburgh, Professor Lorrain Smith and Professor Ritchie have transformed the teaching of pathology, which is now directly associated with bacteriology, with the patient, and with the autopsy. There are some sixty systematic lectures on pathology, twenty on bacteriology, and twenty practical classes; in the hospital there is a course of morbid anatomy. Disease is treated as a *process*, traceable through its clinical and pathological history, and thus pathology is linked with medicine and surgery, and becomes a subject of vital interest. The complete "case-ensemble" is taken as the basis of teaching, providing an incentive to individual investigation and research. At Glasgow, Professor Muir has the assistance of three whole-time lecturers in morbid histology, bacteriology, and clinical pathology, and each student works in pathology during three terms—including attendance at a score of autopsies. The Professor is also pathologist to the Infirmary. At Manchester the systematic course begins with elementary bacteriology to illustrate technique, the proper taking of specimens and duly reporting upon them, with correct interpretation of such reports. Systematic lectures follow on general pathology and pathological chemistry, intimately related with clinical cases and autopsies. Special pathology follows the cases which occur. Here too the Professor has direct association with the hospital. But the hospital and pathological department are unfortunately not in the same premises, and there is need for the establishment of closer relationship or the creation of a pathological institute. Separation of the university instruction in pathology from the pathology of the hospital also exists in varying degrees at Newcastle, Leeds, Birmingham, and elsewhere. In the medical school of St. Bartholomew's Hospital a new pathological institute has been established in the hospital. It consists of departments devoted to clinical pathology, morbid histology and bacteriology, chemical pathology and research. Post-mortem rooms and adjacent laboratories are included, and the whole constitutes one of the most complete pathological institutes in this country. Professor Andrewes has a staff of two whole-time assistants (in special and chemical pathology), six part-time assistants, and laboratory preparateurs. The institute accommodates students, post-graduates, and research workers. The students' course includes systematic lectures, practical work, clinical pathology and bacteriology, and an admirable system of pathological and post-mortem clerkships for students in their fourth or fifth year, analogous to

* The Chair of Pathology at Edinburgh was founded in 1831, and practical bacteriology and morbid histology (at Aberdeen) commenced in 1882.

hospital clerkships, and tenable for three months in the department. The clerks are appointed to the physicians and surgeons, and spend the whole day at this work.

83. The scheme of pathological study at St. Bartholomew's, which is comprehensive and unified, is briefly as follows:—

(a) *Pathological Work in the Ward.*—Clinical clerking and simple routine examination of urines, &c.

(b) *Clinical Laboratory in Institute.* — Pathological clerking (3 months), urines, sputa, blood-counts, fæces, cultures, sections, agglutinations, &c. Elementary bacteriology. Post-mortem examinations and post-mortem clerkships (1 month).

(c) *Pathological Laboratory in Institute.*—Practical pathology and morbid histology, Wassermann reaction, stomach washings, &c.

(d) *Systematic Teaching.*—Lectures, demonstrations, and tutorials in general and special pathology, chemical pathology, morbid anatomy and histology.

84. At the London Hospital there is also a pathological institute comprising post-mortem rooms, instructional and research laboratories of pathology, museum, &c. Systematic lectures and demonstrations are given in the institute, and close association is maintained between the institute and the wards. Every student of the hospital "clerks" in the post-mortem rooms for six weeks. The course in pathology comprises general and special morbid anatomy and histology, bacteriology and clinical pathology.

85. At St. Thomas's Hospital the course consists of lectures (*a*) on general pathology, given twice a week during the winter session; (*b*) on morbid anatomy, illustrated by specimens, given once a week during both winter and summer sessions; and (*c*) on the bearing of pathological chemistry on clinical problems, given during the first half of each winter session. There are a series of demonstrations on morbid anatomy and histology, clinical pathology, and practical bacteriology held during the summer session. There is also a system of clerkships for three months in the post-mortem room making autopsies under supervision; for three months in the pathological laboratory attached to the post-mortem room for advanced students in the clinical laboratory of the hospital, so far as accommodation may permit; and two senior clerkships in practical bacteriology and vaccine therapy, appointments to which may be made every three months. At St. Mary's Hospital the pathological department (with wards) is partly under Sir Almroth Wright and partly under Dr. Spilsbury. The course consists of (1) general pathology, 50-60 lectures; (2) demonstrations of pathology (about 60 a year); (3) a practical pathology class, staining of specimens; and (4) a practical class in clinical pathology, three times a year in blood work, opsonins, cytology, urines, sputa, stomach contents, Wasserman and Widal tests; (5) pathological chemistry; (6) bacteriology; (7) immunity; and (8) clerkships in post-mortem work.

The Limitations of Progress.

86. It will thus be seen that substantial progress is being made in the development of the teaching of pathology. A whole-time expert staff

is now the rule, suitably subdivided in the larger schools; the student is taught directly in the post-mortem room, and usually in the clinical laboratory as well as in his practical class in morbid histology; a system of pathological clerkships is being introduced in the laboratory and post-mortem room, and is proving valuable and effective; the pathological library is coming into vogue; and the museum is becoming supplementary to the instruction of the student, instead of being a mausoleum of curiosities. Above all, a new spirit of research and understanding is abroad in regard to the large and expanding sphere which lies before the science of pathology. Medical research in this field has two branches, as may be seen in the purpose and practice of the Rockefeller Institute in New York: "the first dealing with problems "of disease in their pathological or physiological aspects, and admitting "the fullest use of the experimental method; the second studying "disease as it actually appears in human beings under conditions (in "hospital) favourable to treatment and to scientific observation."* The hope of pathology lies in that effective union.

87. There still remain, however, some serious defects and limitations, and there is still some failure on the part of college and hospital authorities to understand the vital importance of the proper and effective teaching of this subject. The fact is that, broadly speaking, pathology *is* medicine; *it is the study of disease;* it is the first great clinical subject in the curriculum. Biology, chemistry and physics, anatomy and physiology are, in a restricted sense, preparatory to pathology, medicine, surgery, and gynecology; and a right apprehension of the last three depends on a firm and wide understanding of the science of pathology. Yet with two or three brilliant exceptions, there is insufficient organisation of and provision for the teaching of pathology in England to yield a satisfactory general practitioner or to lay the foundations for the best type of clinical work. The principal defect is the lack of co-relation between the teaching of pathology and clinical subjects, the pathological concept or state is set forth on the college side, but it is too often kept separate from the living case, from the *process* of disease and from the end results.

The Newer Methods.

88. Now there seem to be three ways of bringing the teaching of pathology into direct relation with clinical work. First, there is the *staff;* secondly, there is the *place* where pathology is taught; and thirdly, there is the *method* of teaching it. It is becoming perfectly clear that the professor of pathology must be pathologist to the hospital, and he must have clinical assistants as *liaison* officers in the hospital, or one or more assistant physicians or assistant surgeons must be on the pathological staff. In one way or another, there must be a unity of staff; the isolated compartment system in respect of pathology and clinical subjects should come to an end; the centre of gravity must shift from the autopsy to the ward. The clinician should be a pathologist, and should have easy and continuous access to the pathological laboratory; the pathologist should deal with cases rather than specimens; after all, diagnosis and even some forms of treatment now fall in large measure into the hands of the pathologist, and he must be no longer kept out of the ward. Further, there should be such arrangements regarding

* *The Rockefeller Institute for Medical Research*, 1912, p. 9.

remuneration and duties as will allow of ample time for thoroughly sound whole-time pathological work and abundant research. It is both inequitable to the individual and injurious to the system that the clinician should receive high reward and the pathologist low reward. There must be generous provision if the best work is to be done. The professor or director will require assistants in general, clinical and chemical pathology and in bacteriology.

89. Then, secondly, as to place: pathology should be taught in an institute in or adjoining the hospital. The day when it could be taught in a classroom in the University is past; it must be taught in the laboratory and in the dead house. In other words, the pathology class-room must be transformed into an institute, and the institute must be in, or adjacent to, the hospital. An adequate pathological institute will consist of the following:—

(i) A post-mortem department with proper receiving rooms and accommodation for teaching students in the post-mortem room.
(ii) Laboratories for clinical and chemical pathology, for bacteriology, for morbid anatomy and histology, and for research.
(iii) Class-rooms and lecture theatre.
(iv) Preparation rooms and staff rooms.
(v) A library and an educational museum, the latter arranged on the complete case-basis, and not the organ-basis, with full clinical data, documents and specimens (if any), so that the case as a whole may be carefully studied (before being broken up, if and when necessary).

Such an institute will require a staff consisting of the Professor as Director, one or more assistants (according to the amount of work) representing chemical pathology, general pathology, bacteriology, and the clinical side, with adequate laboratory attendants and preparateurs. The work of the clerks (pathological, post-mortem, and clinical laboratory) should be carried out at the institute. It is, of course, a matter for convenient arrangement whether the routine clinical laboratory work on urines, blood-counts, sputa, &c., should be undertaken in such an institute or in a small clinical laboratory attached to the wards. In all cases there should be ample provision both for the clinical pathology of the ward and for the pathology of the post-mortem room, and they should be unified or co-ordinated.

90. There remains for consideration the method of teaching pathology. The subject consists of general and special pathology—which comprises morbid anatomy and histology, experimental and chemical pathology, bacteriology, clinical pathology, and post-mortem examinations. In some schools bio-chemistry is also associated with the teaching of pathology, and it would be well if in all Schools more attention were given to comparative pathology of the animal and vegetable world as a basis of human pathology.

91. Until recently the subject was taught as a "pure" science, the theoretical instruction of the morbid state being applied more or less thoroughly to practical medicine, but the student came thus to look upon the two subjects as independent of each other. In lectures he listened to systematic discourses on inflammation or tumours; in the museum he examined a typical and usually admirable series of diseased hearts,

livers, or kidneys, in glass jars; in the side ward he tested urines; in the practical class he stained his microscopical specimens or made cultures of bacteria; and in the post-mortem room he witnessed autopsies and sometimes examined the organs on their removal from the body. All this was good as far as it went, but it did not go far enough. It was analytic rather than synthetic; it was detached and abstract rather than integral and practical. It did not teach pathology as a living *process*, and hence the co-relation between pathology and clinical medicine or surgery was lost. Happily, there are many signs of a great reform, and the subject is now dealt with on a case-basis, in the manner developed by Professor Lorrain Smith and others. The student is taught to interpret physical signs and clinical symptoms in terms of morbid process, to trace its development, and to examine thoroughly its end results, reconstructing the case from the post-mortem findings, and so learning the pathological history, its causes and conditions, and the various operating factors, physical, bacteriological, chemical, and clinical. Systematic lectures are reduced in number, practical work taking their place; pathological clerkships are introduced; bacteriological work in the clinical laboratory and the actual conduct of autopsies take the place of theoretical classes; the teaching museum is transformed into something of the nature of a co-ordinated and revealing drama in place of a collection of isolated organs; and the student becomes an interested *investigator* of the relation of disease to signs, symptoms, temperature, clinical features, and to the marks of recovery or to the dead organs.

92. Unquestionably this is the way to teach pathology, a method now abundantly confirmed in the most enlightened schools; and university and hospital authorities would do well to make provision in every medical school for the establishment of a pathological institute, or arrangements equivalent to it, for the teaching of general pathology before (or immediately after) the student enters the wards, and for instruction in special pathology to be given concurrently with clinical study and planned on the case-basis.

93. Finally, there is an important reservation to make. In pathology, as in anatomy, there is great need for the study of comparative issues. It may not always be practicable to teach much comparative anatomy or pathology within the medical curriculum, but it is essential that the teacher himself should view his subject *from the comparative standpoint*. Human anatomy and embryology are parts of Comparative Anatomy, and likewise human pathology should be studied as part of a Comparative Pathology affecting both animal and vegetable worlds, for only thus can we hope to secure a sense of proportion or even reliable data. Paget, Hutchinson, Allbutt, Bland Sutton and others have for long advocated this approach to human pathology, and in so doing they followed in the footsteps of John Hunter. Problems of bacterial infection, of tuberculosis, of cancer, of parasitic disease, and of natural immunity, and even the larger biological questions of race susceptibility and of a true system of classification of morbid phenomena receive illumination when studied on the comparative basis. For study and research of this nature it may well be that the pathological institute of a large hospital is ill fitted. Such work demands special provision and appropriate accommodation.

SECTION IX.

THE TEACHING OF CLINICAL MEDICINE AND SURGERY.

The Basis of English Medicine.

94. A substantial measure of the glory of English Medicine has undoubtedly been due to the contribution of Englishmen in the practice of clinical work. In Medicine, in Surgery, and in Obstetrics much has been accomplished since the anatomists and physiologists won their conquests in the 16th and 17th centuries, and, speaking generally, the principles and methods of clinical teaching in England have arisen from the practical experience of English physicians and surgeons in many fields.

The basis of Medicine throughout the Middle Ages had been literary and dogmatic, and had received such inspiration as it had from authority and tradition only. At the Revival of Learning scientific workers and practical physicians turned once more to experimental medicine and a study of the body as they found it. The Revival of Learning had in the medical sphere three famous results. It introduced to Western Europe, and these islands, a new literature (including the works of Galen) from Greek sources, which reached our shores through Grocyn and Linacre returning from the court of Lorenzo de Medici at Florence; it led, as we have seen, to a reawakening of the study of anatomy and physiology; and it stimulated investigation into the medicinal properties of various agents, organic and inorganic, which led to the production at the end of the first quarter of the 16th century of the famous "herbals" and early pharmacopœias.

95. The progress which took place was also the result of other factors, including the social evolution of the time. In the 15th century there had appeared in England the "sweating sickness," and the study of this disease and of rickets made more than one name famous; black death (plague) was still prevalent in Europe; and leprosy occurred in endemic form in Norfolk, Cornwall and Scotland. Then during the 16th century new forms of clinical instruction and examination of the dead were introduced in hospitals in Italy and elsewhere. Montanus (1498–1552) was professor of clinical medicine at Padua before Vesalius had made that school illustrious throughout the world. A century later Sylvius occupied the same position at Leyden, with a successor in the great Boerhaave, and slowly there spread over Europe a new understanding of the importance of the practical study of the signs and symptoms of disease. Harvey's discovery of the circulation of the blood, the mechanical philosophy of Descartes, the teaching of Van Helmont on the relations of chemistry to disease, the physiological investigations of Malpighi, the clinical work of Sydenham, and the steady rise of the spirit of inquiry and scientific research (Bacon, Hobbes, Boyle, Newton) were dominant factors in 17th-century Medicine. It is difficult to over-estimate the great advance in Medicine in England in that century due to the work of these pioneers. The century began with William Gilbert's publication of *De Magnete*, which showed him to be the first of our medical physicists. In 1616 Harvey announced in his *Prælectiones* his discovery of the circulation of the blood; this was followed by the clinical work of Sir Theodore Mayerne, the first of our

medical pharmacologists, who laid emphasis on the value of clinical observation, and who in his turn was followed by Francis Glisson, anatomist, clinician and pathologist, in his work on rickets, and on the liver. He was one of the first to describe a particular disease with completeness, marshalling all the data and recording in proper order the *diagnostica*, *diacritica* and *prognostica*. Lastly came the famous group of Wharton, Willis, Richard Wiseman the surgeon, Lower, and the immortal Thomas Sydenham. The method of clinical medicine in England sprang from the inspiration of these men, reinforced as it was by the physiologists on the one hand and the pathologists on the other. Probably it is true to say that Mayerne, Glisson and Sydenham were the three greatest practitioners of the Art of Medicine of the 17th century—the first as clinician, the second as morbid anatomist, the third as epidemiologist—all three as physicians. "As Mayerne may be said to have first "definitely established in England the clinical study of medicine and "the method of recording observations, and Glisson to have set the "example of the study of the relation of the symptoms to the "anatomical appearance of disease, so," writes Dr. Norman Moore, "Sydenham may be regarded as the first who attempted to arrive at "general laws about the prevalence, the course and the treatment of "disease from clinical observation." They had regard to the condition of the respiration, the pulse, the tongue, the skin, the presence of fever, the physical signs and the medical history of their patients. Thus they established the primary methods of the study of clinical medicine in England. The work of Haller and Morgagni was something more than a counterpart to the work of Sydenham, who studied the signs, symptoms and treatment of disease as he found it in the living by accurate and prolonged observation; Morgagni, on the other hand, did much to lay the foundations of modern pathology by describing post-mortem conditions in relation to the symptoms manifested during life.

96. As the 17th century was thus characterised by the advance of our knowledge of principles, so the 18th and 19th became chiefly characterised by their application. The practitioners of the 18th century—Mead, Floyer, Cullen, Heberden, Fothergill, Cheselden, Pringle, Pott, the Hunters, Withering and Matthew Baillie—left to their successors a rich inheritance of practical work culminating in Jenner's system of vaccination in 1796. The 19th century carried this work on, but brought to play upon the new problems new methods and inventions as well as wholly new discoveries. A system of percussion introduced by Auenbrugger (in 1761) was one of the earliest of the new methods to be widely adopted; it was followed by auscultation, by means of the stethoscope invented by Laennec (in 1819) and introduced in England by Forbes, Stokes, Latham and others. During the 19th century there followed in succession the common use of the microscope, the laryngoscope, the clinical thermometer, the ophthalmoscope, the sphygmograph, and various other methods of recording the heart-beat, the blood pressure and the functions of the body. Little wonder that with these principles and methods to its hand the 19th century marked an enormous advance in our understanding of disease, first in much clinical work of permanent value by Richard Bright, Addison, Charles Bell, Abernethy, Syme, Murchison and Paget, and, second, in the great

new discoveries associated with cellular pathology, anæsthesia, bacteriology and antisepsis. These four fields of labour were not only opened up and illuminated by Virchow, by Simpson and the other anæsthetists, by Pasteur, Koch and Metchnikov, and by our own Lord Lister, but the advance in these fields profoundly altered the whole character and occasion of clinical work. The student of medicine to-day is, by the labours of these men, placed in a fundamentally different position from the medical student of half a century ago. The old necessity for physical diagnosis remains, but a flood of new light has illumined the student's path of study, understanding and scientific method. The apprenticeship system, which was little more than an initiation into the art and mystery of a craft, gave place to scientific clinical instruction in hospital and university. In Western Europe, in England and in America hospitals were thrown open to the student and Universities were founded for teaching and research. The modern renaissance brought with it a more positive and inquiring temper, stimulated a sense of accuracy and of verification, encouraged experiment, and opened a new book of learning and inspiration. Men realised the truth of the famous words of Vesalius, spoken 300 years before, that the study of medicine is the understanding of "that true bible of the human body and of the nature of man."

97. Here, then, we have a great body of human experience and knowledge as an adequate foundation on which to construct a system of clinical education. Here are its elements, as proved by the ordeal of trial —close, continued, penetrating observation; symptoms in the living, signs in the dead; a basis of anatomy, physiology, pathology, human and comparative; the beginnings of pharmacology; systematic physical examination; the invention and use of instruments; vaccination, anaesthetics, antiseptics; and the return to the standard of Nature in place of the canon of authority and tradition. These in the main are the constituent parts of the foundation of the science of clinical medicine and surgery as we find it in England to-day. "After having spent "nearly equal periods of study," said Sir James Paget in 1869, "first "in physiology and morbid anatomy, and then in practical medicine "and surgery, I feel sure that clinical science has as good a claim to "the name and rights and self-subsistence of a science as any other "department of biology; and that in it are the safest and best means "of increasing the knowledge of diseases and their treatment. . . . . "Receiving thankfully all the help that physiology or chemistry or "any other sciences more advanced than our own can give us, and "pursuing all our studies with the precision and circumspection that "we may best learn from them, let us still hold that, *within our range* "*of study*, that alone is true which is proved clinically, and that "which is clinically proved needs no other evidence."* But as Sir James Paget knew, there is a whole world of medical science which does not come within range of clinical study.

The German and English Systems of Clinical Teaching.

98. There are two typically different methods of clinical teaching, the German and the English. Both possess valuable features, and it will be convenient to consider them together.

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* *Life and Letters of Sir James Paget*, p. 241.

99. The German system of clinical instruction in medicine and surgery finds its origin partly in the educational system of the country and partly in the fact that the Schools of Medicine are University rather than Hospital Schools, with their centre of gravity in a professor and his clinic. Both are characteristic. The Professor is a State official, of high position, experience and dignity—the Clinic is a national institution. The Professor is a teacher of authority applying himself to the care of the patients in his charge, to the teaching of a large group of students and to his own research work. He is both a hospital clinician and a laboratory director, but not primarily in private practice. The technical inter-relation of the hospital and university may be various, but be it what it may the Professor is supreme both in the ward and in the lecture theatre. He uses his clinical material as he thinks desirable; he chooses his own staff. By a wide experience in various medical schools he earns and deserves a high repute, and he works by steady degrees of promotion from the lower to the higher places in the professorial sphere. Wherever he is, however, the type of university and hospital is the same, diversity of arrangements not materially affecting the organisation of the clinic or the medical control of the wards, their contiguous laboratories and the polyclinic (from which come the patients for the clinic). The German hospital is constituted of several such units or "clinics" of this kind—nearly always for internal medicine, surgery, psychiatry, obstetrics and gynecology, and ophthalmology, and sometimes for additional subjects such as dermatalogy or pediatrics. The purpose of the Clinic is, like the purpose of the Professor, threefold, namely, the treatment of disease, the education of the student and the pursuance of research. Each clinic consists of wards, lecture theatre, examining, demonstrating and preparative rooms, museum, library, and laboratories for clinical pathology and for research. The institution is a unity of all that is necessary to its purpose, and is complete and thoroughly organised and equipped. The staff consists of the Professor, whole-time and part-time assistants, and volunteer workers. The clinic is subdivided into branches placed in the charge of assistant professors. The staff works together as one team, and its various constituent members seek promotion within its borders or in some other clinic. In each clinic they serve as assistant physicians, investigators and instructors.

100. The process of instruction at a German Clinic is largely accomplished by the lecture demonstration and is mainly deductive. It is a training—in discipline, in technique, in diagnosis—of a man well drilled in anatomy and physiology. The lecture itself is usually comprehensive and exhaustive, profusely illustrated by patients, specimens, diagrams, microscopic demonstrations and so forth. The whole theme of the disease in all its bearings is brought under consideration and minutely discussed, its anatomy and physiology, its etiology, pathology and therapeutics, the hospital findings, the laboratory investigations, all are there. In short, it is a demonstration of Disease, an object lesson in scientific method; it presents to a large body of students at a given moment a picture of the patient—of his past and probable future—it shows them how a case should be examined, diagnosed and treated. It possesses as an educational method, however, some serious disadvantages. It provides no personal experience, no continuity; it supplies an indigestible mass of intellectual material to

an inexperienced and unready pupil; it furnishes no practice or effort on the part of the student. In subsequent study the student is initiated into the practical clinical methods by the assistant professors; he serves also occasionally as a *praktikant* at the lecture-demonstration; he has the option of attending the wards or laboratories as a *famulus* (or clinical clerk without responsibility); and at the close of his medical course he must serve a year's interneship.

101. The English system of clinical teaching may be summarised briefly as the hospital school system. It had its origin first in the apprenticeship system (in which a student was apprenticed to a practitioner) and subsequently in hospital practice (in which a student "walked" the hospitals in the wake of his master). The principle of the system is this:—During the last 2 or $2\frac{1}{2}$ years of the medical course the student works in the hospital ward as a clinical clerk or dresser to the physician or surgeon, one or more patients are placed in his charge, and he is responsible for all the minor medical and surgical attendance they require. He not only observes disease, but under supervision treats it and is placed in a position of responsibility. In addition he "clerks" in the special departments in the clinical laboratory and in the post-mortem room; and, finally, he attends a variety of clinical demonstrations in the wards or the theatre. This English method of clinical instruction springs partly out of the history of medicine in England, partly out of the association of the medical schools with the hospitals, and partly out of the national spirit.

The Clinical Curriculum.

102. We have already seen that in order to provide a sound medical training in respect of our knowledge of the human body in disease, it is necessary (*a*) to study the beginnings of disease, and its physical signs in all its stages; (*b*) to learn the principles and methods of the care of the body and the treatment of the disease affecting it; (*c*) to foresee the immediate and remote issue, and the meaning of the character and form of death when it supervenes. It is incumbent, therefore, now to consider what, in the passage of the years, has been found by experience to be the kind and degree of clinical training in England which answers these high necessities. Two broad elementary conditions at once emerge. First, the student in England is brought, as in his study of anatomy, back to Nature, back to the human body—not books, not didactic instruction, not even lecture-demonstrations, not the tradition and authority of the canon of the law, but the body of the patient is the centre of his learning. Secondly, upon the student is cast at once and all through a direct burden of personal responsibility; he is to learn by doing, by experiment if you will, and, at all events and at all times, by practice. In order to fulfil the three great requirements named above he must be prepared in ways and means; then he must be brought in touch with the disease at its initiation; subsequently he must treat his patient, and lastly he must foresee the course and end and weigh its meaning.

103. The clinical curriculum in England is much the same in London and the provinces. But for convenience the usual practice in this country may be quoted:—

(i) In his third year, after passing his intermediate examination and before or at the commencement of his clinical studies,

the student has *Three Months' Clerking in the post-mortem room and Clinical Laboratory* with attendance at a course of *Elementary Clinical Medicine and Surgery* (physical diagnosis, clinical methods, examination, bandaging and duties of clerking). Post-mortem clerking includes attendance at autopsies for several consecutive weeks, the student himself undertaking autopsies. During 26 two-hour lessons in the clinical laboratory at the London Hospital and in the wards, the clerk is taught practically the clinical pathology necessary for private practice, including examination of sputum, diphtheria swabs, urines, vomit, test meals, blood, Widal reactions, fæces, urethral discharges, cerebro-spinal, pleural and abdominal fluids and the examination of sections. In this laboratory is also carried out all immediate hospital pathological work, the more elaborate investigations being referred to the Pathological Institute. At St. Bartholomew's Hospital simple routine pathological tests, the examination of urines, &c., proceeds in the ward, and all other clinical pathology is referred to the Pathological Institute situated in the hospital precincts in which is established a well-equipped clinical laboratory for dealing with urine, sputum, blood counts, cultures, fœces, sections and agglutinations. In this Pathological Institute there has been established an admirable system of "pathological clerking" for three months for each student. At Newcastle (as in some of the London schools) each ward has attached to it a small clinical laboratory, the "secretion room," and here arrangements are made for students to undertake clinical bacteriology, blood work, cardiography, urine and sputum examination, &c. In this school medical and surgical tutorial classes are held on physical signs, bandaging, dressing, &c., and there is three months' post-mortem clerking. At Manchester, during the first three months of their clinical work at the hospital all students must attend preliminary courses of practical instruction in medical physical diagnosis, clinical laboratory methods and elementary clinical surgery (splints, instruments, bandaging). They must also do practical dressing in the accident room or out-patient department. At Liverpool students attend the post-mortem demonstrations during 12 months and are post-mortem clerks for six weeks. At Sheffield it was recently the custom to require three months of post-mortem clerking, during which the student himself performed a dozen autopsies.

(ii) *Six months' clerking in medicine.*—The clerks, say eight or ten in number, are attached to one physician, assistant physician and house physician (70 beds). Each clerk keeps notes of his cases, conducting examination of clinical material and taking charge of his case day by day. He also attends clinical demonstrations in ward and bedside instruction.

(iii) *Six months' dressing in surgery.*—The dressers (six to eight in number) are attached to one surgeon, assistant surgeon and house surgeon (80 beds). Each dresser takes charge of his cases and the treatment, dressings, preparation for and

assistance at operation, &c. He attends clinical demonstrations in ward and receives bedside instruction. Dressers also take their turn on day and night duty periodically for three days in the receiving room, residing in the hospital temporarily. All English medical schools adopt the system of requiring their students to serve as "clinical clerks" in the medical wards and as "dressers" in the surgical wards. In all cases this appointment involves charge of patients under supervision of physicians and surgeons, bedside instruction, attendance at clinical demonstrations in the ward, and the actual performance of medical and surgical treatment. It is a system of day by day apprenticeship under direction, necessitating close contact between teacher and student and student and patient. Associated with these appointments are many special opportunities of practice in giving anæsthetics (some schools requiring a dozen, a score, or even 40 administrations) and of the subsequent after-care of the patient. Different schools adopt different methods for facilitating the personal work of the students. For instance, at Newcastle, Professor Rutherford Morison was accustomed to train his dressers to act as assistants to the house surgeon. The scheme included (i) special training in proper dressing methods, (ii) full preparation of case notes, (iii) attendance in accident room alternately with ward work, and (iv) ten days' work as "assistant house surgeon"—routine duties, ward visits, application of all dressings, testing urines, performing minor operations, assisting at major operations and taking surgical out-patients.

(iv) *Three months' clerking in Obstetrics and Gynecology* (in-patient and out-patient)—two months in the lying-in wards and one month's district maternity practice (20 cases).

(v) *Three months' dressing in Special Departments* (ophthalmology, orthopædic, dermatology, radiography, anæsthetics, aural, throat, cardiac).

(vi) *Out-patients.*—All students clerk in the medical out-patients, and dress in the surgical out-patients' for three months and receive practical instruction. They also serve as clinical assistants in the receiving room. At St. Bartholomew's, St. George's and other hospitals special out-patient clinics are held.

(vii) *Clinical Lectures and Demonstrations in Medicine and Surgery* are attended every week. These clinical lectures form a characteristic feature of all English medical schools. They are delivered frequently by senior members of the staff and are illustrated by patients and specimens. Sometimes they are given in the wards, at other times in the theatre. It is the usual practice for physicians and surgeons to lecture either upon their own speciality or upon cases of particular interest in the hospital at the time. The lectures are essentially demonstrative, clinical and practical, and the clerk or dresser of the cases exhibited has a direct share

in the preparation of the demonstration. By this means the student receives guidance not from one Professor of Medicine or Surgery, but from half a dozen Specialists in their respective subjects.

(viii) *Instruction in Vaccination and Fevers* (by attendance at fever hospital and under vaccination officer).

(ix) *Operative Surgery.*—One month's course of operations on the dead body, each student being required personally to perform the operations allotted to him.

(x) *House appointments.*—One of the most valuable characteristics of English clinical education is provided in the resident appointments held subsequently to qualification for periods varying from six to twelve months. In addition to upwards of 500 dresserships and clerkships, there are, for instance, 130 appointments at the London Hospital alone made annually, salaried or resident, for students who have become qualified. It will thus be seen that during the last half of his medical course the student is continually in some office of responsibility, in direct or continued contact with the patient and himself fulfilling the duty of medical practitioner. He is in immediate charge of a few cases and in contact with many (medical, surgical, gynecological, casualty).

The English method, in Mr. Flexner's view, "fills every requirement " of sound and thorough teaching. The student observes the patient " from all sides: he notes symptoms at the bedside, he examines secreta " and excreta; he sees both sets of facts in the light of the case history; " he watches progress and development, for he visits his patient daily " from the time of admission to the day of dismissal; he can form his " own conclusion, proposing whatsoever procedure his experience or " reading suggests to him. In all these steps his faculties are in " continuous and complete exercise, every activity germane to the " occasion—observation, inference, diagnosis, treatment—being inti- " mately and continuously correlated with every other. And all the " while the welfare of patient and student are absolutely safeguarded, " for the student's observations and suggestions are promptly checked " up, criticized, and revised by his superiors in the wards and the " laboratories. He has every inducement and opportunity to active " and responsible exercise of his faculties under conditions that entirely " deprive the opportunity of the peril of inexpert medication."*

104. Clinical education in England is thus primarily practical. The student learns mentally concurrently with the establishment of "a " veritable sense experience in the wards," and he "acquires the art " of medicine by increasingly intimate and responsible participation " in the ministrations of physician and surgeon." And all this happens to the surprise of the critical observer in hospitals voluntarily supported and privately managed, which it is admitted on all hands are the better for the presence of the Medical School—better for managers, medical staff, nurses and patients.

* *Medical Education in Europe*, 1912, *p.* 208.

Its Advantages.

105. It may be assumed at once that this English method of clinical training possesses definite advantages and some imperfections, and a word may be added on each. First of the advantages is that the system carries out the great principles of English medicine. The student is brought to observe Nature for himself; he is counselled, he is supervised, but he himself is the workman, the observer. "In entering this place, even this vast hospital," said Dr. Latham to his clerks at St. Bartholomew's Hospital long ago, "where there is many a significant, many a wonderful thing, you "shall take me along with you, and I will be your guide. *But "it is your own eyes, and your ears, and your own minds, and, "I may add, by your own hearts, that you must observe and learn and "profit. I can only point to the objects, and say little else than 'See "here and See there.'*" The method is not that of a large class of hearers of the law from the lips of authority, a Professor; it is a band of disciples and doers serving under a Master. That is the core of the matter. No lectures can supply the essence of such instruction, for there is no other way whatsoever of acquiring true learning. Secondly, the system establishes an invaluable relation between student and patient. Knowledge of the intermediate subjects and knowledge of human nature are here blended in a relationship which directly concerns effective treatment of the patient and effective teaching of the student, who by this means enters *a process of becoming* a physician or a surgeon. Thirdly, by this system, things in the art of Medicine are taught which cannot be taught by lecture, which do not lend themselves to demonstration. The signs and symptoms of disease or injury, whether long foretold or in the form of emergency, lie wholly beyond the reach of the lecture theatre; the sense of touch, the *tactus eruditus*, manual dexterity, the estimation of solidity or fluidity of swellings, their mobility or fixity, their hardness or softness, their smoothness or irregularity, can be learned only by the laying on of hands; and, again, disease is multiform, never quite the same in two individuals, never lending itself to standardisation, and so the observer must not only see and perceive and handle, but he must do this many times for one patient and for many; and, once more, the instruments of treatment, whether appliance, medicament or application, demand immense practice in use for the acquirement of any satisfactory degree of skill. Lastly, by this system of clinical training the student is, as we have seen, continuously holding medical office. He thus becomes inured to responsibility and sensitive to the call of duty to his patient.

Its Limitations and Imperfections.

106. The chief limitations of this English System of clinical teaching are three. First, though practical medicine is rightly viewed as art rather than science, its principal need at the present time is a larger measure of the scientific spirit. The pursuit of medicine is a practical and tentative art, to be learned by practice. "Our art," wrote Sydenham in the preface of his *Observationes Medicæ*, "is not to be better learned than by its exercise and use." The science of medicine is, in the abstract, another thing. But between the extremes of narrow craft on one side and complete philosophy on the other

there lies, as we have seen, the land of the "middle proposition," Mills' *generalia*, Locke's "intermediate principle." Perhaps it is true to say that in that element lies the necessity, and the necessity is science, the scientific method and spirit. "Science is the captain," said da Vinci, "practice the soldiers." Let me name some examples. The student's practical clinical work has a tendency to become too empirical, he follows a scientific method without the inspiration of the scientific spirit. There is too little correlation between the intermediate subjects and the clinical subjects, and he fails to bring to the bedside the facts of anatomy and physiology, of pharmacology and pathology. There are indications of improvement, particularly in respect of pathology, but his science is not permitted to keep pace with his art. Again, insufficient attention is given in some schools to the scientific examination of all the systems of the body, the only accurate grounding in clinical method. Mistakes in general practice commonly arise from the temptation to deal with the patient too expeditiously and to fail to inquire thoroughly into each system. This is overcome by contracting a habit of detailed examination, system by system, integumentary, muscular, nervous, circulatory, respiratory, excretory, and so forth, providing the data of organised *case-taking*—a custom which is capable of great development in the way of requiring critical exposition as well as record. Knowledge of a clinical condition is complete only when it embraces the physical, chemical, morphological and functional sides. Diagnosis is dependent upon the correct estimation and bearing of all the data available, and no perfunctory and slipshod ways should be permitted in the student. Another example is in the neglect of the science of therapeutics, and particularly of prognosis. "Whoever considers the matter thoroughly, will find," wrote Sydenham, "that the principal defect on the part of "physic proceeds not from a scarcity of medicines to answer particular "intentions, but from *the want of knowing the intentions to be answered*, "for an apothecary's apprentice can tell me what medicine will purge, "vomit, or sweat or cool; but a man must be conversant with practice "who is able to tell me *when is the properest time* for administering "any of them." The when and how and what and why of treatment, particularly in clinical medicine, is not being as thoroughly handled as it might be. In an earlier section of this Memorandum I have suggested the method of the *therapeutic clinic*, and by that, or some other means, the whole business of pharmacology and therapeutics should be brought by the student into the ward, and close attention given to the Hippocratic idea of prognosis. Innumerable are the social inconveniences and hazards which follow the trail of incorrect prognosis. The insurance case, the factory worker, the school child, everybody who is a patient desires sound advice on this point. It is not only a question whether the malady is sooner or later likely to prove mortal; it is the faculty of imagination applied to the process of disease in the patient before us. What is likely to happen? and when and how? and can it be forestalled, or minimized, or avoided? What are the sequelæ of this or that condition? What, in short, are the issues for better or worse of this malady for this man?

107. A second imperfection arises from failure to deal thoroughly with the early or incipient stages of disease. In the ward the student observes disease in its gross and serious form. He sees and feels and

hears the signs of advanced disease of heart or lung or nervous system, and for various reasons this is inevitable and necessary. But in his subsequent general practice it is the beginnings of disease which he must handle, the subjective symptoms—"symptoms are the body's mother-tongue"—which bring the patient to his door, the first warnings, the early pain. That is when disease should be recognised, for that is when it is amenable and when its sequelæ and issues are preventable. The hospital and the laboratory stand for the ultimate results, the private practitioner is the outpost who ought to be expert and wholly adequate at the moment of invasion. How is this to be secured? The answer is by bringing the student in contact with the out-patient, with the patient in the receiving room or the dispensary, and with the child, for thus he will learn to recognise the beginnings of disease and can study its *process*. The out-patient department, using the term for an idea rather than a place, has not yet been fully utilised in the education of the student. I am satisfied there is need for great development and expansion in this sphere.

There are not half a dozen medical schools in the country where the student is continuously and properly taught in the out-patient department. Indeed nothing could be more remote from true educational method or spirit than the clinical work which sometimes characterises out-patient treatment or the teaching of students in these departments —a hasty glance, a bit of paper, and on to the next patient, a situation inferior to that of a busy morning in the waiting room of a certifying factory surgeon or an over-driven panel doctor, a handling of the patient which is actually mischievous training for the student. Yet the out-patient department should play an important part in his education.

108. The third chief imperfection of the English system of clinical teaching is its lack of organisation. The master among his disciples is not primarily devoted to teaching, but is all too often the over-worked physician and surgeon. What are the daily duties of such a professor? He has charge of the sick in the hospital; he has his private practice, which when he has reached the dignity of a hospital physicianship may be large, onerous and lucrative; he has his duties as teacher of his clerks and lecturer on his subject, for which he is unpaid or under-paid; he has official work for his university or hospital, and many public duties fall to his lot; he must keep up his reading, his records and his learned societies; and he is, or should be, deep in tasks of research and investigation. No one who knows the numerous and insistent claims of a large consulting medical or surgical practice, with its appointments, its operations and its travelling, can doubt the issue of such a life—it inevitably prevents, in some degree, the way of the teacher, the scholar, the thinker, and the research worker. A man cannot serve two masters. That is the predicament of the clinical teacher in England. And there is only one solution. *He must be paid as a teacher.* At present he must often sacrifice his teaching to his practice; and in point of fact the claims of private practice tend to make serious inroads upon the regular, continuous and routine teaching work of the senior staff. Here and there a successful teacher can afford to sacrifice his practice, but the rule is otherwise.

109. The results of this lack of organisation are not, as some clinical teachers assume, unimportant or insignificant. They are little short of

disastrous, as a few illustrations will indicate. Here is a London Medical School of the first rank with a large and eminent staff, but there is only one clinical lecture per week or twelve in a term; here are four other London Medical Schools with the attendance of the clinical teaching staff irregular, intermittent and unreliable, owing to the prior claims of practice; and here is an example of a school where the physicians and surgeons teach only their own clerks. Now the results of such conditions absolutely preclude clinical teaching of university standard. There may be plausible excuses or even unavoidable causes for the existence of each condition, *but such conditions make first rate clinical education impossible.* Twelve clinical lectures in a term including medicine, surgery, obstetrics and the specialities are wholly inadequate; uncertain attendance of clinical teachers demoralizes the class; for a group of clerks to be limited to instruction from one teacher confines their whole outlook. Nor are any of these defects necessary or inherent; they are due to lack of organisation and proper provision. At St. Bartholomews, at the London, and at University College, the clinical teaching includes for all students, regular and numerous lectures by the whole staff, medical group consultations and clinical demonstrations in special subjects. It must not be supposed that London is unique in shortcomings in regard to clinical teaching. For some of the best clinical teaching in the world is to be found in London. Moreover, the provincial medical schools share with some of the metropolitan, (*a*) insufficiency of organisation of, and preparation for, formal clinical teaching, (*b*) inadequate instruction in fevers and in mental diseases, (*c*) a rather perilous tendency to split up medicine and surgery into disconnected specialities, (*d*) a failure to use advantageously auxiliary hospitals for particular diseases, (*e*) insufficiency of house appointments, or resident clinical assistantships, and (*f*) a relative deficiency in clinical research. Further, it must be added that some of the provincial schools (*e.g.*, Manchester, Newcastle, Sheffield, Birmingham) suffer from the serious disadvantage that the hospital and the school are inconveniently distant from each other.

The Solution of the Problem.

110. The solution of the problem thus presented is not easy. The roots of the position run deep into the past and spread widely underground. There is interest and prejudice and personal habit and time-honoured custom with which to contend. The doctrinaire determines a solution on lines of his *ad hoc* doctrine; it should be thus and thus he declares, because thus only is it pedagogically or philosophically correct. The teacher views the matter from his point of view, he would like to make the best of both worlds or, if devoted to education, he is liable to the desire to see all things under his feet; the profession must be thus and thus, and the teacher should be supreme. The private practitioner, hitherto somewhat unjustifiably left out in the cold, would demand, had he a voice in the matter, that the training course in medicine should fit him for the competent discharge of his professional duties, should, in brief, equip him for the difficult and hazardous journey which lies before him in the unknown. And the student has his eye on the portal of entry to the profession, the examination room. From these four sources—and the

public and the patient, alas, are not yet interested enough to claim a hearing—come different, confusing and even conflicting answers to the question for decision. One thing is certain, that the present examination system creates a thraldom of its own. And upon that I desire to repeat the remark that training should not be standardised to the examination, but that the examination should test the training. A vast and almost immediate benefit would accrue to the whole business of clinical education in this country if the basis of the Degree Examinations was the training the student had received and not certain items of information which, on a given date, he was able to furnish to the examiner. If the medical work of the examinee was assessed—his theoretical and practical work, his preparations, slides and drawings, his reports of cases, the records of his clerking, dressing and clinical pathology, and the results of his class examinations—and could form a substantial portion of the Degree Examination, we should immediately see an improvement in the system of education. Cramming and other forms of alchemy would disappear, and the purpose of training would be its own intrinsic value, the equipment of a practitioner of medicine and surgery, and not an artificial test on a theoretical basis at a given date in an examination hall.

111. Apart from any reform of the examinations, it must be said that, broadly speaking, the solution of the problem of clinical teaching is a reorganisation of the system in such a way as to place a greater responsibility on the teacher, and provide—

(*a*) for the appointment and adequate remuneration of professors of clinical medicine, surgery and obstetrics* who would devote the greater part of their time to teaching and research; though such professors need not be wholly debarred from private practice (success in which is a valuable asset in teaching work), they should be prepared so long as they continue to be head of their clinical department to be primarily teachers, and only in a minor degree practising consultants; in other words, their first and predominant interest must be in the University;

(*b*) that the qualifications for such appointments shall be clinical experience and proficiency, *ability to teach*, sound scientific training, high character, enthusiasm, and capacity to investigate, to lead and to organise; promotion should be by merit and not by seniority or length of time on junior staff or prolonged service to the hospital; the duty of the post would be the treatment of the patients, the investigation of disease and the teaching of the student;

(*c*) that the professor shall have the control of wards (50–100 beds), an out-patient department and ample laboratory accommodation (in immediate proximity to the wards) for research and clinical pathology (cardio-respiratory work, bacteriology, microscopy, X-ray and electrical work, &c.).

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* In some schools it would be practicable and desirable to appoint professors of neurology, psychiatry, pediatrics and other subdivisions of medicine.

(*d*) that the professor shall have an adequate professional staff of tutors and assistants of university status, properly paid and graded, consisting of some whole-time men and some part-time (including those engaged in practice), sufficient in number to permit of small clinics, and representative of the various branches of medicine and surgery, all of which cannot be taught by a single professor. The lesson of team work is thus inculcated, and the student learns the necessity of it in his subsequent practice.

(*e*) that the scientific clinical instruction shall be of university standard, and shall include—

(i) the present system of clerks and dressers in the wards, special departments, laboratories, out-patient department, post-mortem rooms, &c., (case-taking, clinical instruction, therapeutics, laboratory), combined with tutorial work in clinical methods and physical diagnosis;

(ii) clinical "bed-side" teaching in the ward;

(iii) clinical lecture-demonstrations outside the ward;

(iv) clinical teaching in the out-patient department;

(v) clinical work in various special hospitals (which should be affiliated with the school)* including mental diseases, fever hospitals, skin hospitals, children's hospitals; in tuberculosis, venereal disease, ophthalmology, diseases of nose and throat, diseases of infancy, orthopædics, mental diseases and operative surgery;

(vi) junior house appointments of various degrees and in special as well as general hospitals.

Each of these six methods of obtaining an adequate training in clinical medicine has its own importance. Some university and hospital authorities lay emphasis upon one, some upon another. They are all widely practised in English medical schools and form constituent parts of the English system. It is erroneous to suppose that the clinical lecture-demonstration is a feature peculiar to German Medicine. It has been elaborated and relied upon there; but it is essentially British in origin and of universal use, and in this country it forms a part of a system, it is not the system itself. These lectures should be given regularly by the Professor and his associates, and should be most fully prepared, differentiated to the needs of the student, and abundantly illustrated. Such lectures should be supplementary to, and not in substitution of, clinical teaching of clerks and dressers, (*a*) at the bedside, (*b*) in the ward, and (*c*) in the small informal clinic. Such class teaching should include instruction in methods of clerking and dressing, examination, investigation and treatment, physical signs and symptoms of disease, clinical pathology (laboratory testing of urine, blood, sputum, &c.), special forms of therapeutics, the following up of cases by after-care or at the autopsy. In the surgical and gynecological departments such instruction will include bandaging, dressing, antiseptic methods and minor surgery. In the out-patient

* An admirable illustration of this method of making available the clinical material at special hospitals (children, mental, nose and throat, ophthalmic, &c.) is to be found in the recent development at University College Hospital, London.

room it will take the form of the physical diagnosis and symptoms of early disease.*

112. The need of English Medicine above all others at the present time is the opportunity for the cultivation of the laboratory method and the scientific spirit in the teaching of clinical medicine and surgery. The method is there and the spirit, but a lack of organisation prevents the occasion. The conquests of physiology and pathology must be brought into the ward and applied by the clinical teachers; and appropriate arrangements must provide (1) for the close and integral association of the laboratory method with the clinical method, and (2) for the full exercise and unification of the two great branches of clinical teaching which Great Britain has taught to the world—the hospital bedside apprenticeship system and the clinical lecture-demonstration of university standard.

* An account of the daily working of such bedside clinics appeared in the *British Medical Journal*, 1914, i, pp. 10–16 (Sir William Osler, Bart., F.R.S.).

SECTION X.

OBSTETRICS AND GYNECOLOGY.

113. Although the practice of Midwifery is of ancient origin the progress of its growth as an integral part of the medical curriculum has been relatively slow, due in part to the relatively great advance in the practice of midwives in whose hands it has been since time immemorial, in part to the rapid development of Gynecology in recent times, and in part to the natural difficulties inherent in the education of the student in this subject. But it is significant that the obstetrician and gynecologist is the great example of the unity of medicine and surgery in actual practice. Here is the full integration.

114. The subject is obviously one of exceptional importance, indeed, in some ways, it is the most important branch of medical practice. For, first, it is concerned with the birth-rate, the survival of the race; and, secondly, each confinement represents two patients, the mother and child. Then the experience of modern civilisation shows that unskilled midwifery brings in its train a long catalogue of trouble, some of which manifests itself in the hospital ward and the lying-in institution, but most of which has hitherto hidden itself in the home. In 1916 there were 3,978 deaths of women recorded in England and Wales as due to pregnancy and child-birth. That loss, much of which is directly preventable, is serious enough, but probably the great mass of incapacity and suffering among women and children which has not ended fatally is an even more terrible loss.* A vast number of women are made invalids for life, or become sterile, or die ultimately from injuries received or diseases acquired while fulfilling, or attempting to fulfil, the function of motherhood. How great and widespread is this kind of physical disability has been brought to light in the excessive and unanticipated sickness returns of women claiming benefit under the National Insurance Act.† In the solution of this problem the medical profession would appear to have some responsibility. For it is, after all, in large degree, a problem of medical attendance and of skilled nursing. The function of reproduction and of child-birth is natural and physiological. Its exercise ought not to entail a high death or sickness rate, and the medical profession should be able to make an invaluable contribution to the safety of child-birth. It can only do so by effective and adequate training of every medical student in Obstetrics, and the provision of skilled assistance to the practitioner in complicated cases. Nor should the student be less well equipped to deal with the closely allied subject of Gynecology. Speaking generally, minor gynecological maladies provide in the mass a much greater bulk of disease than the major, and both major and minor are due principally to two preventable conditions, namely, venereal infection and unskilful midwifery practice. Here, then, is the opportunity for the general practitioner (if he be properly trained and educated as a student); for unskilful midwifery is due to two principal causes,

* *See Maternity: Letters from Working Women*, 1915.

† Report of the Departmental Committee on Sickness Benefit Claims under the National Insurance Act (Cd. 7687), 1914, pp. 47–52.

inadequate training, experience, or equipment, or careless or hurried workmanship due to insufficient remuneration, pressure of practice, &c.

115. The teaching of the two subjects of Obstetrics and Gynecology should be taken together, and should be taught practically. The old-fashioned theoretical lecture has relatively little scope in this subject, for midwifery is pre-eminently practical and includes in exceptional degree the application of anatomy, physiology, pathology and preventive medicine. Clinical lecture-demonstrations, tutorial tuition, and work with the mannikin and pelvis are necessary, but the burden of training must be clinical practice.

Present Arrangements.

116. The Regulations of most of the chief licensing bodies in England in regard to this matter require a minimum number of 20 extern cases of labour to be attended by the student. This condition has been prescribed by the General Medical Council: in certain instances the student must undertake the work with the aid and under the supervision of a qualified medical man, in other cases he is not required by regulation to have any such assistance. The more stringent regulations made by the Universities of Oxford and Cambridge in this regard have reacted on the teaching practice of the London Hospitals, which in the main provide the clinical instruction for students of these Universities. Consequently, the requirements of Oxford and Cambridge have come to be more or less insisted upon by the Hospital Authorities in the case of students who are working for the degrees or diplomas of other licensing bodies. For instance, the practice at a London Hospital is to devote three months out of the five or six years' curriculum to instruction in midwifery, the period being utilised as follows. During the first month the student is resident in the hostel attached to the college (two sets of chambers are set aside for such students), and while there the student is in attendance day or night to the lying-in wards. There is a working arrangement by which certain cases in these wards are set aside every week for medical students. The ten intern cases so studied by the student are undertaken with the aid and under the guidance of a qualified accoucheur. During the second month the student attends the gynecological ward, where he sees difficult cases and their proper treatment, *e.g.*, cases of contracted pelvis, eclampsia and so forth. As the whole of his time during the first month and during the third month described below may not be fully taken up, he attends the gynecological wards during those periods also. During the third month he takes his extern cases in a district adjoining the hospital, in which for the time being he becomes resident. During this period he attends 20 extern cases, summoning to his aid when in difficulties the junior resident accoucheur from the hospital (who attends with him on his first three cases). In certain hospitals it is necessary to comply with following rules:—

(1) Daily visits to be made in normal cases on the first five days and on the seventh day of the Lying-in; the case to be reported by the student on the eleventh day. In abnormal cases daily visits must be paid and reports made to the Junior Accoucheur.

(2) Temperature charts to be kept for each case, such charts to be left hanging up in the maternity room for inspection.

(3) No assistant on being called to a case in labour and leaving before the patient's delivery shall be at liberty to attend another case without first informing the Junior Resident Accoucheur.

A student at a London Hospital therefore sees ten intern cases in the Lying-in Ward, about a dozen difficult cases in the gynecological ward, and 20 extern cases. His three months' course in Midwifery and Gynecology may be summarized as follows: First month, (*a*) daily attendance in the lying-in wards and (*b*) in-patient and out-patient gynecological clerking; second month, in-patient and out-patient gynecological clerking; and third month, extern maternity practice. In the metropolitan and provincial schools a somewhat similar course is followed. There are systematic lectures to attend, and three months' obstetrical and gynecological clerking, with 20 extern cases. Some Medical Schools supplement the minimum course by providing for one month's residence in a lying-in hospital, and practically all schools provide in greater or less degree preliminary instruction in practical midwifery at the outset of the course.

The London School of Medicine for Women arranges the following courses, as the Authorities of the School naturally take the view that it is highly important for medical women to have received a thorough training in this subject:—(1) course of twenty lectures on midwifery; (2) twenty lectures on gynecology; (3) ten demonstrations in practical midwifery; (4) five demonstrations in practical gynecology; (5) course of practical midwifery extending over six weeks, which includes three weeks' clerkship in a lying-in hospital attached to the London School Medicine for Women, and three weeks' clerkship in the Extern Maternity Department attached to the Royal Free Hospital. During this six weeks' course the students also attend daily demonstrations given by the resident obstetric officers, and at the infant clinics attached to the two hospitals; (6) three months' clinical clerkship in the gynecological wards of the Royal Free Hospital, or elsewhere; (7) attendance during three months at gynecological out-patients; and (8) a course of six classes in operative midwifery previous to the final examination. At least twenty labours must be attended.

117. In view of all the circumstances and of the importance of satisfactory education in regard to ante-natal hygiene, the care of the pregnant woman, obstetrics, and gynecology, it is necessary that the training set out above, good and practical as it is so far as it goes, should be both wider and more intensive. For whilst it is true that many of the general principles of clinical medicine and surgery apply equally to the practice of obstetrics and gynecology, it is also true that these latter subjects are almost entirely novel, and peculiar and difficult to the student. They are inherently so; but beyond that they suggest new questions of all sorts to his mind, new phases of his intermediate studies, new applications of his clinical experiences, new social relationships. He has studied anatomy—but not deeply or thoroughly the anatomy of the pelvic floor, of the uterus and its appendages; and his physiology has not included special consideration of the physiology of the female generative organs, the child *in utero*, the mother during gestation, or the whole function of lactation; and his pathology has only acquainted him in the abstract with the complications of pregnancy—tuberculosis, heart disease, nephritis, diabetes and obstetric pathology. Moreover, the anatomy, physiology and

pathology of pregnancy must be studied in the living, though post-mortem morbid anatomy, including the examination of still-born fœtuses, must also be included. At present, it cannot be said that the Medical Schools are providing their ordinary students with a sufficient knowledge of the most scientific kind regarding these things and their relation to gynecology. Yet in private practice and in hospital the medical practitioner will at once meet with large numbers of cases—hitherto, perhaps, temporarily put off with a diagnosis of "debility"—which are incapacitated, invalided and unskilfully treated cases following child-birth. Above all, the student is not being taught midwifery from the standpoint of preventive medicine. It is not sufficient to require mere attendance on 20 cases of child-birth, to be got through somehow. There are direct and serious responsibilities resting on medical practice during the ante-natal stage, at the confinement, and post-natal. The maternal accidents of confinement, the gynecological conditions following unskilful obstetrics and the infant mortality incidental to child-birth must be prevented. The need is insistent and widely recognised. It must be added also that the difficulties in the way of an effective training are considerable.

Proposals for Further Training.

118. But some suggestions may be offered. First, in these two subjects exceptional use must be made of models, charts and specimens. There must be a liberal supply of mannikins, normal and abnormal pelves, fœtal skulls, obstetric instruments and wet specimens in order that the student may obtain some degree of familiarity with the subject before he handles the patient.

Secondly, there should be more careful clinical teaching on normal cases as a preliminary study. This should be done in the first instance in the lying-in hospital or maternity home—where resident medical officers should be called upon to undertake teaching—and subsequently in extern work the student should receive more definite and personal instruction from a competent teacher. Similar attention should be given to the clinical pathology of obstetrics and the relation of syphilis to premature and abnormal pregnancy.

Thirdly, the period of "clerking" in the lying-in institution might well be lengthened and made more useful to the student, for at present there is a large amount of wasted opportunity; if possible, the student should become resident for one month to three months. This alone would be an invaluable addition to his curriculum and give him a more thorough grounding in obstetrical method.

Fourthly, wherever possible an increased number of cases of delivery should be undertaken, above the 20 at present prescribed by the General Medical Council.

Fifthly, more clinical use should be made for teaching purposes of lying-in institutions, women's hospitals, poor law infirmaries, maternity centres, dispensaries for women's diseases, and venereal centres and clinics. This is particularly important and necessary as a means of providing for the student extended facilities for gynecological clerking. In this relation it is desirable to safeguard the proper susceptibilities of the patient, who is naturally sensitive, and

arrange that no patient should be examined as a rule by more than, say, two students.

Lastly, instruction should be afforded (in co-operation with the physician for the diseases of children) in the care of the newly-born child, in infant nursing and management, and in ante-natal hygiene. At University College Hospital, at St. Thomas' Hospital, at Manchester; Sheffield and elsewhere, infant clinics and schools for mothers are being utilised for teaching purposes with great advantage.

"The medical students throughout the country," wrote Professor Donald, of Manchester, in 1916, "should receive a more thorough "training in practical midwifery than is at present the case. More "facilities should be given for medical practitioners to have post-"graduate instruction. A week or two spent in a modern maternity "hospital would bring many of them up-to-date in methods of "diagnosis, of aseptic precautions, and of treatment generally. The "large cities are now provided with maternity hospitals, and this "system should be extended to the smaller towns and even to country "districts. The study of the pathological problems connected with "abortion and still-birth should be stimulated by the provision of "well-equipped clinical laboratories in connection with maternity "hospitals."

SECTION XI.

PREVENTIVE MEDICINE.

Introduction.

119. There is scarcely any subject or department of Medicine so strangely neglected in the course of medical education as that of Preventive Medicine, Hygiene, or Public Health. It is neglected in the examinations and in the teaching courses; it is neglected both in respect of time allocated to its study and the nature of the study required. A brief course of a dozen or twenty theoretical lectures only is included in the fourth or fifth *annus medicus*. That is the sum total of requirement, and the following is the scope set out in the examination regulations of the Conjoint Board of the Royal Colleges of Physicians and Surgeons, which are widely adopted throughout England:—

(*a*) Water in relation to health and disease. The character and classification of drinking water; impure water and its purification; diseases conveyed by water and methods of dealing with them.

(*b*) Air in relation to health and disease. Impurities of, and diseases conveyed by, air; principles of ventilation, quantity of air necessary for health.

(*c*) Soil in relation to health and disease. Impurities of, and diseases connected with, soil; methods of dealing with such diseases and with excreta and sewage.

(*d*) Food in relation to health and disease. Dietetics, adulterations, and diseases connected with deficiency or impurity of food.

(*e*) The dwelling house and principles of house drainage.

(*f*) Principles of disinfection and mode of action of chief disinfectants.

(*g*) The notification of disease.*

The terminology of this syllabus is sufficiently comprehensive to cover a wide ground, and in the hands of a competent teacher and with sufficient time and suitable equipment a course of lectures might be made of educational value. Even so, there is a significant absence in this standard syllabus of all reference to some of the most vital elements of personal and public health—for example the principles of epidemiology, the etiology of disease, eugenics, infant and child welfare, school hygiene, the ordinary requirements of sanitary law, health insurance, vital statistics, the effect of climate and meteorology on disease, hospital

* The Syllabus of the University of London is as follows:—Principles of personal hygiene and of regulating the sanitary construction of the dwelling; overcrowding and its evil effects; diseases liable to be conveyed by water and food; etiology and prevention of the more commonly occurring endemic and epidemic diseases, including isolation and disinfection; power and legal obligations of the medical practitioner; elements of medical statistics, including meaning and interpretation of birth and death rates; causes and prevention of infant mortality; and the correct certification of the causes of death. The Calendars of the various Universities include little more than is comprehended in this syllabus or that of the Conjoint Board, and in many cases much less. A syllabus may not be an accurate indication of the contents of a course, but the assumption is the reverse.

provision and management, the sanatorium system, parasitology, the disposal of the dead, bacteriology in relation to the public health, the principles of infection and immunity, vaccination, prophylactic inoculation, tropical diseases occurring in this country, venereal and other social maladies, the relation of poverty to disease, factory hygiene, industrial poisoning, poor law medical work, and the duties of the medical practitioner in respect of preventive medicine and his relationship to the sanitary administration of the country. Here are a score of hygiene problems of everyday importance to the private practitioner and not one word is said of them. It would also be easy, even at the present day, to discover Medical Schools in England in which no adequate instruction is provided in these subjects. Nor is any attempt usually made to introduce practice, experience or "field work" into the teaching of this subject. A consulting physician, or more frequently a local medical officer of health, fulfils the meagre duty of part-time or occasional teacher. He is poorly paid or unpaid, and his course for medical students is brief, wholly inadequate, and often uninteresting. The student remains passive, inattentive and unconcerned, knowing full well that he is not likely to be "referred" in examinations in this subject for sins of commission or omission. It is not surprising therefore that he goes out into the world almost entirely ignorant of the "setting" of his professional studies, of the relationship they bear to human society and the great social problems which he will soon discover to be pressing around him. He is wholly without sense of proportion in the matter, and possesses not even the elementary data for true perspective. His first patient may be a pauper, but he knows nothing of the local arrangements of poor law treatment; his second a midwifery case, but he has been taught nothing of the practical operation of the Midwives Act and little of the wide prevalence of disability among women owing to unskilful medical and midwifery attendance; his third a case of industrial poisoning, but he is uninformed regarding factory hygiene, or how or why his patient was poisoned, or what the remedy is, or whether compensation is available; his fourth patient may suffer from tuberculosis, but he does not know of the sanitary machinery of the area in which he lives for dealing with this disease, its diagnosis, its notification, its isolation, or its prevention; the fifth may be a case of rickets, and the student reflects on *cranio-tabes*, thickened bones, hypophosphites and meat juice, but he forgets the dark and crowded tenement which has produced the child and of the futility of the advice which he innocently offers; or again, his patient may have the measles, and he is ignorant of the far-reaching and complex problems of preventive medicine involved in such a simple malady; or, lastly, he may be the medical adviser of an artisan family in sickness, but has never been told that half a dozen local health bodies, and as many medical officers, are interested in various members of that family, and that the State has provided numerous instruments and agencies for its redemption or alleviation, which it is his business to use. The fact is the medical student is not sufficiently taught to associate his pathology with his clinical medicine, and *both of them with the social life and conditions of his patient.* "Preventive Medicine," said Sir John Simon, "is the province where Medicine joins hands with common sense."

Place of Private Practitioner.

120. Now, in the practice of Preventive Medicine the first line of defence rests with the medical practitioner, who should himself form an integral part of any scheme for the practice of Preventive Medicine in his area. The appointment by the municipality of a medical officer of health does not absolve the medical practitioner. It is a profound fallacy to suppose that Preventive Medicine is a speciality in the field of medicine, separate and apart, like psychiatry or ophthalmology, as something which does not concern the ordinary general practitioner, and therefore lies rather outside the sphere of minimum medical education. That fallacy is due to a misunderstanding both of the scope of Preventive Medicine and of the necessity of the medical student being at least as well equipped in it as in clinical medicine—for he is to become a practitioner of it, a teacher of it to his patient, and in all probability an official in its service. Thus the advance of Hygiene depends in large measure upon his equipment, knowledge and practice, and between that advance and that equipment there is a deeply instructive historical ratio, having the roots of its evidence in the past records of every parish in the land. Before discussing the kind of training the student should receive it is desirable to refer briefly to the scope of the subject.

Scope of Preventive Medicine.

121. Preventive Medicine or Hygiene is the great medical subject of the future. It may share its fortunes with Obstetrics and Child Welfare, but its place is assured. As it advances, the importance of the clinical subjects will decline; as it increases they must decrease. "Hygiene really forms the connecting link," wrote Dr. Andrew Combe long ago, "by which all the branches of professional knowledge are "bound together and rendered available in promoting human health "and happiness; and in one sense is the most important subject for "a course of lectures, although very oddly almost the only one which "has not been taught systematically; and I consider the absence of "the connecting principle as the main cause why Medicine has advanced "so slowly."

122. For Preventive Medicine stands in human thought for prevention rather than cure. First, its ideal is to subdue, restrict and, in the far future it may be, annihilate the tendencies to morbid variation in the healthy body of man. Its purpose is to prevent not only the spread of disease, but its *occurrence*. Secondly, it is concerned with the causes and conditions of disease which must be sought and known, and then brought under control. And thirdly, in achieving this, or attempting to achieve it, Preventive Medicine must determine and secure the maximum of those optimum conditions of life for the individual and the community which form the frontier defence against the enemy of disease and death. In other words, the science and art of Preventive Medicine has an object which is twofold: it seeks to avoid the occasion of disease and physical disability by anticipating it, by escaping it, or by protecting the body against it (*prophylaxis*); and it aims also at husbanding and controlling the physical resources of the individual and the community in such a way and to such a degree that

the individual lives the healthy life and can exert unhampered his full powers of natural resistance to the invasion of infection or strain (*hygiene*). The machinery by which these ends are to be attained involves a new relationship between the medical practitioner and the State (*State Medicine* or *Public Health*). This comprehensive understanding of Preventive Medicine is something much wider than the removal of nuisances, sanitation and drainage, or even than the notification of disease, the isolation of infectious cases, the disinfection of the home, and the compilation of records. These things are among its instruments. Its purpose is *prevention* of disease by removing its causes and conditions, by reducing the spread of disease through contagion or infection, and by the development of the physical resistance of the individual.*

123. The foundation of Preventive Medicine is, therefore, a knowledge of the *nature of disease*. Since the time of Hippocrates, and long before his day, there have been many attempts to define the nature of disease. Before the Germ Theory, emphasis was laid upon the individual, his heredity, habits or environment; in the heyday of the Germ Theory the tendency was to attribute the origin of disease to the germ, its prevalence, invasion or virulence. Subsequently it became clear that disease is a complex phenomenon arising as a result of many factors, and is largely a question of relationship and relativity. In the case of an infective disease, such as tuberculosis, for example, we may say that there is the *seed* or infecting agent, the *soil* or infected body, and the *external conditions* influencing both seed and soil, separately and in relation to each other. Not one of the three factors alone can produce the disease we know of as tuberculosis. The specific agent is a vegetable bacterium having a physiological life history of its own, breeding true, though having varieties or stages of evolution. It can be cultivated separately from the body in suitable artificial media, possesses biological features and chemical character, and will reproduce the disease if inoculated into a susceptible animal, from which in turn it can be separated again. There are well known external conditions which are favourable, as there are others which are unfavourable to its separate existence. Its virulence can be increased or diminished, its life prolonged or shortened. Then there is the soil, man's body, in which it is sown, and grows by multiplication setting up two progressive changes, one degenerative and destructive, the other regenerative and constructive, for as it grows it produces toxins which exert changes in the body-cells and fluids creating, under certain conditions, a state of immunity. By artificial inoculation of modified germs or their products from previous cases it is possible to produce an acquired immunity in other persons. In the struggle between the

* The Royal Sanitary Commission of 1869 (on which sat Sir Thomas Watson, Sir James Paget, Sir Henry Acland and Sir William Stokes, and before whom Sir John Simon and Dr. Farr gave evidence) defined the public health requirements of civilised social life as follows: (*a*) the supply of wholesome and sufficient water for drinking and washing, (*b*) the prevention of pollution, (*c*) the provision of sewerage and utilisation of sewage, (*d*) the regulation of streets, highways and new buildings, (*e*) the healthiness of dwellings, (*f*) the removal of nuisances and refuse, and consumption of smoke, (*g*) the inspection of food, (*h*) the suppression of causes of disease, and regulation in case of epidemics, (*i*) the provision for the burial of the dead without injury to the living, (*j*) the regulation of markets, &c., public lighting of towns, (*k*) the registration of death and sickness. *Report*, vol. i, p. 20.

seed (the parasite) and the soil (man's body) it is possible that the germ may be victorious and the body succumb, or it is possible the body by its protective cells may be victorious and the germ succumb. In any case, the germ may pass from one person to another. As in agriculture, the seed only comes to its full maturity outside or inside the body under favourable conditions. Many persons carry in their bodies the bacillus of tuberculosis without suffering from any clinical form of the disease because their bodies are resistant. Speaking generally, the condition of the body is the dominant factor, and thus the human race survives the invasion of the unseen hosts of infecting germs. But always in infective disease the issue is between parasite and host, and the favouring or unfavouring conditions of their relationship. This, in theory, is the problem stated in crude and simple form—but, in fact, the problem is highly complex. There are the evolutionary and degenerative processes undergone by the bacillus, for bacteria are subject to the laws of development and decay like other species of plants and animals. There is a rise and fall of prevalence and of virulence, and the factors which produce them, hence the rise and fall of disease. The history of leprosy, plague, cholera, sweating sickness, influenza, scarlet fever, or measles indicate cyclical character, a phenomenon only imperfectly understood. There is also the effect of heredity, nurture, nutrition, environment and habit in man's body making it a more favourable or a less favourable soil for the growth of seed sown in it. The same conditions may materially affect the relationship of the seed after it is sown in the soil. A person of sound heredity may become susceptible to disease by poor social circumstances, lack of food, fresh air or exercise; and, conversely, the effects of an unfavourable ancestry may be modified by the application of hygiene. Nor are these things of individual import only, for the prevalence of epidemic disease depends upon a whole series of factors of a communal nature, the age and sex distribution of the population, its density, its character, the birth rate, the marriage rate, the conditions and customs of society, peace or war, food or famine, the prevalence or otherwise of disease, the physical and climatic conditions, dryness or moisture, prevailing winds or autumnal temperature, urban or rural life, healthy or unhealthy occupation. The philosophy is simple, the practice complex.*

The Rise of Preventive Medicine.

124. The origin of these first principles of Preventive Medicine lies far back in the past. It must not be confused with the superstructure which has been built on the foundations, nor with the ways and means which have been found serviceable in combating or controlling disease, which have grown out of our knowledge of the *nature of disease* or, rather, out of our knowledge of the structure and function of the healthy body. It was the ravages of pestilence in England in the Middle Ages—of leprosy from the twelfth century, of the "black

* "I would say that the province of Hygiene is to examine the relations existing between the human constitution, on the one hand, and the various external objects or influences by which it is surrounded, on the other; and to deduce from that examination the principles or rules by which the highest health and efficiency of all our functions, moral, intellectual and corporeal, may be most certainly secured, and by obedience to which we may when once diseased most speedily and safely regain our health."—Dr. Andrew Combe (1797–1847).

death" from the fourteenth, of sweating sickness in the sixteenth, of cholera and of the small-pox—which first impelled the study of the conditions which seemed to be responsible for such epidemics. Witches, papal bulls and charms proved inadequate, and empirically reliance came to be placed more in fire, water and air as elements of prevention. Quarantine and cleanliness became necessary. Then the new learning of the medical renaissance threw a flood of light on the nature both of health and of disease. Beginning with the publication of *De Contagione* by Fracastor in 1546, and *De Rerum varietate* by Cardan in 1557, we pass to the applied physiology of Harvey and Malpighi, the physiological mechanics of Descartes and Borelli, and the practice of Glisson and Sydenham which culminated, in the last part of the seventeenth century, in the theories of contagion and epidemicity enunciated in England by Sydenham and in Italy by Ramazzini (1670–1713). Fifty years later came the quarantine recommendations of Richard Mead (1673–1754), followed by Pringle, Lind and Blane in regard to the hygiene of armies and navies (1750–1780), by Baker on lead-poisoning (1767), by Morgagni on pathology (1682–1771), by Jenner on vaccination (1796), by Farr on vital statistics, and by Pasteur and Koch on the etiology of morbid processes. The value of the new learning was not only knowledge, but method. Harvey and Malpighi added to human knowledge, but still more they introduced the scientific spirit and the experimental method, and in laying the foundations of physiology they began also the science of etiology and preventive medicine.

125. Thus the ravages of plague and pestilence taught men the *conditions* of disease, and the advance of medical knowledge taught them its *causes* and the true basis of the normal from which such disease was a departure. Strong social factors also played their part in the struggle with disease. The "dooms" of the Early English Kings, the Guilds of the Middle Ages, the sanitary laws of Edward I., the courts leet, and the cleansing and quarantine regulations were the forerunners of Sanitary Authorities and a multitude of Acts of Parliament in our own time having for their object the prevention of disease. And alongside this development, and, indeed, as part of it, there was the industrial revolution with its profound changes in the occupation of the people (Thackrah, Greenhow and others), the political evolution with its social ambitions and desire for self-expression (Ruskin and Morris) and self-government, and perhaps greatest of all the powers of the new humanity, morality and religion—all these influences affected the question of the health of the nation and the worth of the individual life.

126. Nor must it be forgotten that in our own time vast social and scientific movements have rapidly developed, which have resulted in the growth of new "social tissue," and have been "gradually transforming human society itself," so that the "atomic" view has been replaced by a more "organic" conception.* It is this profound change which goes far to alter the outlook, position and opportunity of the medical practitioner—a situation wholly without parallel and yet almost entirely neglected by the medical authorities responsible for the education of the student. I am convinced that the vast

* *See* Mr. Sidney Webb's brilliant exposition of this revolution in Chapter xxiii of the Cambridge Modern History, 1910, pp. 730–765.

changes in the social order of things—affecting the individual, the family, the community—makes necessary a new and larger understanding of what the student must be taught in Preventive Medicine. Most assuredly the inter-relationship of the practice of medicine and of the social evolution is of deeper significance to him than much of the burden of unimportant technical detail with which we zealously attempt to overload his memory. It is idle to declare that the practitioner "does not want this, or cannot use that, because he is not going to be a Medical Officer of Health." The fact is that his ignorance of his relationship to the community and his detachment from the social evolution proceeding around him has been a substantial contribution to his great hurt and undoing as a practitioner, and has not seldom shut him out from a large and liberal education in medicine.

Its Objects.

127. Such being the elements in the rise of Preventive Medicine, the objects which, as a science and an art, it has had in view are not less practical. They may be named as follows :—

(i) To prevent disease arising or spreading.
(ii) To reduce the death rate.
(iii) To prolong the span of man's life.
(iv) To increase the physical capacity and powers of resistance of the individual and the community.

Much more has been achieved in all these four directions than is generally supposed by the average medical student. Leprosy, sweating sickness and plague have disappeared in England; cholera has been barred at the ports; the small-pox is vanishing under our eyes and, compared with only a century ago, is relatively a rare disease; typhus or gaol fever is rarer still; and typhoid and diphtheria are yielding to improved water supply, isolation and antitoxin. A generation ago many large towns in England had 500 to 1,000 cases of typhoid every year, and now do not get a dozen apiece. Here is an immeasurable saving in treasure and in life! Sick workers lose wages amounting to millions of pounds every year, and they become a charge on the State for treatment and insurance amounting to millions more. To reduce the total amount of sickness is a vast scheme in social economy as well as in health. To increase the birth rate, to save infant lives, to prevent premature death, to prolong a man's days of capacity is to add to the wealth of the nation. Then there is the death rate. In 1867 the general death rate for England and Wales was 20·6; in 1917 it had fallen to 14·4. In the same period the infant mortality rate fell from 153 to 97 per 1,000 births. And the death rate for infective disease showed a substantial decline. In 1866 Sir John Simon pointed out that 15,000–20,000 deaths from typhoid must be expected in England every year; but in 1916, though the population had increased from 22 millions to 34½ millions, the number of deaths in England and Wales from typhoid had fallen to 1,100. Since 1869 the reduction in the total death rate from all causes has been such that the State saves 300,000 lives per annum which under former conditions would have been lost, and the typhoid death rate in England and Wales has fallen in 50 years from 390 per million per annum (1869) to 32 per million per annum (1916). Length of days

has also increased, the expectation of life at birth now being 51 years, as compared with 40 years in 1838–54.

These are among the victories mainly due to Preventive Medicine in its broadest meaning—death is postponed, suffering and disablement is reduced, life is prolonged. It is less possible to say whether the resistance of the individual is greater than in former times. Some of the conditions and habits of civilisation appear to have exerted an opposite tendency, though much is now being done by improved sanitation, child welfare and artificial immunity to fortify natural resistance to disease. But, however that may be, the conquests of the past are sure and certain; though it seems to be a primal curse of Preventive Medicine that its triumphs are invisible. The tragedy is obvious; the escape from tragedy is unseen.

What should be taught to the Student?

128. What, then, is it necessary to teach the medical student in the sphere of Preventive Medicine? I submit that he should have definite and systematic guidance, accompanied where possible by practical work or field-work in the following divisions of the subject:—

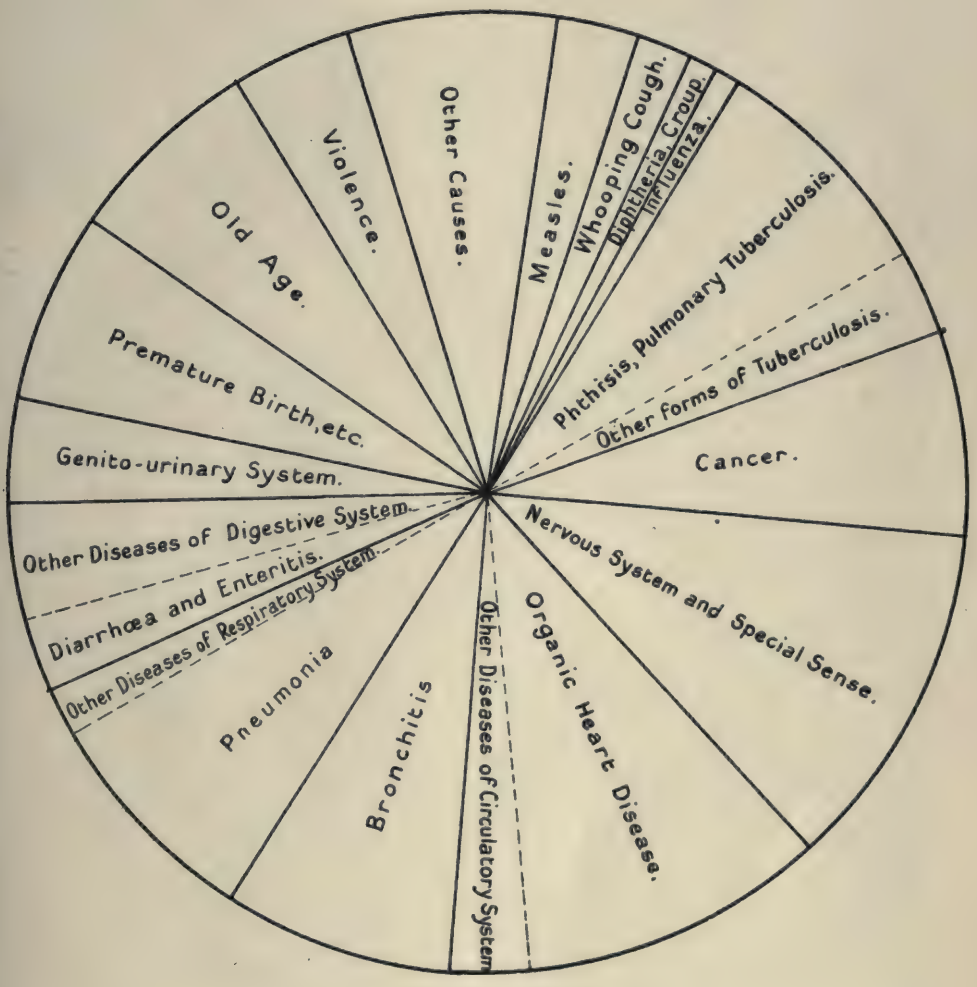
(i) *The Study of the Causes and Conditions of Disease in relation to Social and Communal Conditions.*

The principal diseases which produce disablement or death are tuberculosis, venereal disease, infective disease, respiratory, circulatory, nervous and alimentary disease. In the Report of the Registrar-General for 1912 (issued 1914) is presented a Chart and table as follows:—

ENGLAND AND WALES. DEATHS FROM THE PRINCIPAL CAUSES, 1912.

Disease.	Number of Deaths.	Proportion per 1,000 Deaths from All Causes.
Measles	12,850	26·4
Whooping cough	8,410	17·3
Diphtheria, croup	4,340	8·9
Influenza	5,350	11·0
Phthisis, pulmonary tuberculosis	38,080	78·2
Other forms of tuberculosis	11,970	24·6
Cancer	37,320	76·6
Diseases of nervous system and special sense	53,900	110·7
Organic heart disease	47,770	98·1
Other diseases of circulatory system	13,390	27·5
Bronchitis	39,730	81·6
Pneumonia	37,350	76·7
Other diseases of respiratory system	7,410	15·2
Diarrhœa and enteritis	11,560	23·7
Other diseases of digestive system	19,370	39·8
Diseases of genito-urinary system	19,370	39·8
Premature birth and diseases of early infancy	31,410	64·5
Old age	32,430	66·6
Violence	19,780	40·6
Other causes	35,150	72·2
Total	486,940	1000·0

ENGLAND AND WALES - PROPORTION OF DEATHS FROM THE PRINCIPAL CAUSES TO TOTAL DEATHS 1912.



129. Here in graphic form we see the disposition of the enemy. In his study of pathology and clinical medicine the student will learn something of the causes and conditions of disease from the pathological point of view. *Tuberculosis* may be named as an example. The student will have been taught that tuberculosis is an infective disease, of various forms, due to a bacillus which produces certain morbid conditions made manifest by clinical signs and symptoms; that there are various methods of diagnosis; and that there are certain portals of infection, particular means of treatment, and well known post-mortem lesions. His knowledge of tuberculosis *quâ* disease is, or should be, adequate and serviceable. But there is a further field of knowledge concerning this malady which is necessary to him for any real comprehension of the situation and for any effective handling of his patient. He requires to appreciate the magnitude of the social evil of tuberculosis, its mortality, its prevalence, its sickness rate, and its economic effect; what is its history in this country, what the degree of its infectivity and infectiousness, and what its principal sources or channels of infection, what the factors in its causation? What is the relation between animal and human tuberculosis, and thus the relation to the consumption of meat and milk? or in what degree is the occurrence and character of tuberculosis affected by the structure of the lung; by environment, by climate or soil, urban or rural conditions, housing and ventilation; by social circumstances, poverty, occupation or fatigue; by personal habits of dietary or alcoholism; by domestic circumstances of uncleanliness, overcrowding, child-bearing? Again, what can be done for the patient beyond palliative medication—the open-air life, nutrition, graded exercises, modification of occupation, heliotherapy? Is the case suitable for a Sanatorium or for a Hospital, and how is the patient admitted, and what is the regimen, and what the prospects? Lastly, what is the relation of the medical practitioner to the means of prevention—notification, isolation, disinfection, prevention of indiscriminate expectoration, education, insurance, compensation? These matters are not, and should not be, dealt with by the Professor of Pathology, but it cannot be said they are immaterial. They are profoundly important in the relation of the tuberculous patient to Society, and they illustrate the elements upon which Preventive Medicine is built.*

130. Again, *Measles* is a common malady. There were in 1917 as many as 533,000 notifications in England and Wales and 10,000 deaths. The medical student has seen very few cases during his training course, though he has been taught the principal facts concerning symptoms and treatment. But here again we fail to equip him adequately in regard to differential diagnosis, complications, sequelæ, treatment and prognosis. And over and above the clinical character of measles he is insufficiently informed as to the incidence and mortality of the disease, and the social circumstances which profoundly modify, even govern, its course. At what age is the mortality highest, at what stage in the attack, due to what complications, and produced by what social circumstances? what is the effect of measles on a rachitic child, and what its relationship to tuberculosis? how serious and widespread through the nation is the disablement due to this "childish complaint"

* *See* Report of Departmental Committee on Tuberculosis, 1912, pp. 16–17.

body, both in growth and in disease, a sympathy which results in a readier disturbance and endangerment of the whole body by local conditions which in the adult would have little or no general effect; and, lastly,

(*d*) childhood is the time for remedy and for prevention, partly because the body is responsive and susceptible, partly because childhood is the occasion of education, growth, of repair and of strengthening the natural defences of the body.

134. These four points are equally important in all infant and child welfare work. In the hospital the student meets with disease in its gross and final forms; in the home or school the practitioner meets with disease in its incipiency and earliest beginnings. Only so will his work prove valuable, timely, educational and preventive. It is in childhood that the tree may be bent, and the student should be taught in the out-patient room and elsewhere to be observant of the rickety child, the "pre-tuberculous" child, the mouth-breather, the mal-nourished child, the early decay of teeth, the effects of adenoids or measles or rheumatism, *and of those minute departures from the normal which foretell the coming of disease.* The student who has an eye only to gross forms of disease has not been properly educated; for to ignore the profound and far-reaching effects of malnutrition, of measles, of intestinal toxins, of high blood pressures, of rheumatism or of dental caries, is to ignore the essentials of preventive medicine. Yet these things are not always sufficiently considered in the Medical Schools.

135. Somewhat similar lessons await the student and the practitioner in connection with the existing system of National Health Insurance, which, it must be remembered, had two objects in view: first, the provision of early treatment for the beginnings of disease, and, secondly, the provision of treatment for all employed persons above 16 years of age, a universal system for those in need of treatment which could not be otherwise provided. The title of the Act names specifically that its purpose is the avoidance of the "loss of health, and the prevention and cure of disease." We have already seen that the scheme involves the service of 15,000 doctors on behalf of 14,000,000 patients. The panel doctor is called upon to perform certain duties as a condition of the remuneration paid by the State for his service. He has to provide certain medical certificates, keep certain records regarding his patients, and furnish effective treatment, "improved as compared with what it has been possible to give in the past." * A proper standard should be reached and maintained in regard to visits and advice, time and attention devoted, and diagnosis and treatment. But to secure efficiency this means, before everything else, that the panel doctor must be strong in diagnosis and competent in dealing with the beginnings of disease; and also it must be added, he should be better equipped in laboratory provision and special appliances than hitherto. One of the principal objects in view is to bring the diseased, and therefore unemployable, citizen to effective treatment promptly and at an early stage of his malady. But this means a corresponding equipment of the student. At present he is not taught sufficiently

* National Insurance Statements, 1912 [Cd. 6520], p. 13.

either the diagnosis and treatment of early disease, or the way in which the State provides the benefits of insurance (medical, sanatorium, sickness, disablement and maternity).

(iii) *Relation of Disease to Environment and External Conditions.*

136. A third division of the subject to which the student's mind should be directed concerns the relation of external conditions to disease. In recent years there has been a remarkable advance in almost everything which conduces to a healthy environment. The sanitation of the dwelling-house, the condition of the streets, the removal of refuse and excreta, the provision of a wholesome water supply, the control of food, the sanitation of schools, the improvement of the factory and workshop, are signs of immense progress, and have no doubt exercised a direct and indirect effect in diminishing sickness and reducing the death rate. But alongside these beneficent changes there are opposing factors. There is still proceeding the aggregation of the population in towns; the steady increase continues in the number of persons, men and women, living in an industrial environment; the majority of the population remain implicated in an unequal struggle with poverty; hundreds of thousands of people live in overcrowded cottages or tenements; and there exists a vast mass of ignorance and carelessness in regard to domestic and personal hygiene. Broadly, these are the external conditions which contribute to bring about 500,000 deaths a year (486,939 in 1912) of which half occur under 50 years of age and a quarter under 5 years of age, and which contribute also to a large body of suffering and disablement. The medical student is a witness of some of this disease and mortality, *but he is not being taught the relation of it all to the social life of the people.* He has been told that water or milk may convey the germs of disease, and that "bad drains" are unwholesome, but he finds himself in practice without knowledge or equipment regarding the daily operation of the common circumstances of social life, under which a quarter of a million people die prematurely every year.

137. There are two particular points to which his mind should be directed, namely, his patient at home and his patient at work. What are the conditions obtaining in the homes and workshops which create the environment, for better or worse, in which the patient lives? They can be measured and their effects estimated by a study of the death rate of a town. In 1906 the death rate of one of the divisions of London (population 101,000) was 20·7 per 1,000, but its sub-areas showed a death rate varying strictly in accordance with social condition; its census enumeration areas varied in death rate from 8 to 36 per 1,000; and its infant mortality varied from 41 to 375 per 1,000 births. What does this mean? It means that in one community of 100,000 the death rate varies between very wide limits. When it is tracked down to its lair it is found to be highest without exception where there is a high density of houses and population, a high percentage of poor class tenements, a high percentage of poverty, and a low standard of social life and domestic sanitation. In that year in that same community, with a general death rate of 20·7, the death rate in four-roomed homes was 6·4 per 1,000, in three-roomed homes 14·8, in two-roomed homes 22·5, and in one-roomed homes 39·0 per 1,000.*

* Report on the Public Health of Finsbury, 1906, p. 26.

Precisely the same result occurred in the five consecutive years during which the observation was made, and similar observations in Glasgow and other large towns yielded a similar result. There are various points to consider in such analyses, and certain qualifications and reservations must be made, but the broad deduction is self-evident. There is an intimate relation obtaining between the morbid condition of the patient and his social environment, between certain diseases and housing conditions, between the occurrence of "return" cases of infectious disease and overcrowding.*

138. Of hardly less importance is the effect of industrial conditions on health. The Factory and Workshop Act applies to 123,000 factories and 154,000 workshops, giving employment ordinarily to some six or eight million people. From the early days of the Industrial Revolution until the present time, evidence has shown the burden of disease and disability arising from conditions of occupation (Thackrah and Greenhow) from long hours, from poisoning and accidents.† Recently investigations have shown that industrial strain, night shifts, heavy work and unduly prolonged hours of labour are responsible for diminished output, broken time, absence from work, and a large amount of physical disability, fatigue and sickness. The examination of upwards of 2,000 women munition workers yielded 5 per cent. of severe fatigue and 35 per cent. of slight fatigue; 20 per cent. of these women suffered from anæmia, 23 per cent. from indigestion, 26 per cent. from disorders of the menstrual function, 27 per cent. from dental disease, and from 21 to 28 per cent. from nervous conditions. Further, it was shown that if the industrial conditions were improved, canteens provided, hours of labour reduced, and night work prohibited, health and the working capacity at once improved, with the additional economic result that output was increased.‡ The investigation illustrated the terms of a great experiment in the application of the scientific method. Given certain conditions, certain results followed. Broadly speaking, the vast bulk of the burden of industrial ill-heath is removable by (*a*) proper attention to the health of the child and the adolescent; (*b*) by a satisfactory system of industrial hygiene; and (*c*) by skilled obstetrical and gynecological treatment of women.

139. Closely associated with the condition of the home and the workshop in relation to disease are special social evils, like alcoholism and venereal disease. We are now the witnesses of two national movements for the control of such evils. The physical results of the restrictions on the sale and consumption of alcohol introduced by the Liquor Control Board since 1915 are profoundly significant, and seem to indicate the possibility of a substantial reduction in the mortality due to excessive drinking of alcoholic beverages.§ The action being taken at the present time in regard to the control and prevention of venereal disease may be found to yield not less hopeful results.‖

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* *See also* Reports of Poor Law Commission, 1838, and the evidence of Chadwick, Arnott, Kay, Southwood Smith, and Farr.

† In 1914 there were 159,413 factory accidents (1,287 being fatal) reported to the Home Office. *See also* Report of Health of Munition Workers Committee, 1918 [Cd. 9065].

‡ *See* Report of Health of Munition Workers Committee, 1918 [Cd. 9065].

§ Fourth Report of Central Control Board (Liquor Traffic), 1918 [Cd. 9055].

‖ Report of Royal Commission on Venereal Diseases, 1916 [Cd. 8189].

(iv) *Sanitary Administration.*

140. The ravages of disease opened the Statute Book for Public Health in 1832,* and the insanitation of the towns led to Chadwick's reports and the Sanitary Commissions in 1843–45 out of which grew the Public Health Act of 1848, the first comprehensive measure which formed the groundwork for the great Public Health Acts of 1872 and 1875. The Duke of Buccleuch's Commission of 1845 advised the appointments of local medical officers of health to inquire into the sanitary condition of each town, "*to ascertain the true causes of disease* "*and death*, more especially of epidemics increasing the rates of " mortality and the *circumstances which originate and maintain such* " *diseases* and injuriously affect the public health." This was the commencement of the present sanitary code and the existing sanitary administration. The medical student should know that in each town and village of the country there are some eight or ten governing bodies concerned with public health†—a veritable palimpsest of local authorities—supervised, aided or directed by another eight or ten central departments of State; he should be familiar with the principal means of administration as it affects domiciliary and institutional treatment; and he should know how best he may co-operate with the machinery of government for the benefit of his patient and the treatment of disease—its diagnosis, investigation and prevention. In a word, the agencies of curative medicine and of preventive medicine should be no longer regarded separately, but should co-operate sympathetically, continuously and all along the enemy's front.

(v) *The application of the Scientific Method.*

141. In no branch of Medicine has the scientific method, introduced in the seventeenth century and developed in application in the nineteenth, been more serviceable than in Preventive Medicine, and above everything else which the medical student may gain from an understanding of its scope is the advantage of the organised use of the scientific method in place of the empiricism of the barber-surgeon or the apothecary. The observation, classification of facts, verification, deduction and standardization of experience which the student has found to lie at the basis of clinical medicine lie also at the basis of Preventive Medicine, and have resulted in the slow building-up of a national fabric of ideas and organisation with which the student must become familiar. For instance, there is—

(*a*) the careful study and investigation of the causes of disease;
(*b*) the notification and registration of sickness, its character, incidence and distribution;
(*c*) the isolation and treatment of the case (including serum therapy);
(*d*) the disinfection, when necessary, of the premises;

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* It was the outbreak of cholera in 1831 which led to the Quarantine Act of 1832; a second epidemic in 1849 led to the Common Lodging Houses Act of 1851, and the Metropolitan Act of 1852; and a third epidemic in 1854 led to the Nuisances Removal Act and the Diseases Prevention Act of 1855.

† For poor law, sanitation, education insurance pensions, hospitals, asylums, water supply, mental deficiency, &c.

(*e*) prophylactic vaccination and inoculation, and the control of "carriers";

(*f*) the adoption of special methods of prevention varying with different diseases.

142. These are a concrete expression of the scientific method which is also needed in husbanding and fortifying the physical resources of the people as a whole. It is necessary to strengthen the normal quite as much as to prevent or cure disease. The science and art of Medicine is not restricted to the diagnosis and cure of disease in its gross forms; it includes also a knowledge of how disease comes to be, of its earliest beginnings, and of its prevention. It is, in fact, the science and art of Health, of how man can learn to live a healthy life at the top of his capacity of body and mind, avoiding or removing external or internal conditions unfavourable to such a standard, able to work to the highest power, able to resist to the fullest, growing in strength and efficiency. The new Preventive Medicine must not be understood to consist only of sanitation. The fight against disease is something more than the closing of its channels of communication, something more than an avoidance of the ways and means of its infection and invasion, certainly much more than a registration of its effects, a record of the morbidity and mortality which follow in its train. The turning point of the battle is elsewhere. The first line of defence is *a healthy, well-nourished and resistant human body.* And to this end the whole man must be dealt with, for he is something more than animal. His body is, in greater or less degree, the instrument and expression of emotion, intellect and will. There is thus a psychological aspect of preventive medicine hitherto greatly neglected. Nor is the individual, taken at any one moment, the whole of the issue. There is his life history, his heredity, his family, his domestic life, his personal habits and customs, his home as well as his workshop. In short, preventive medicine to be effective must deal with the man, the whole man, as an individual as well as a member of the community. The human being is a finely-adjusted physiological instrument, which must no longer be wasted, much less destroyed, by ignorant or wilful misuse. A working man's capital is, as a rule, his health and his capacity to perform a full day's work. Once that is impaired or damaged beyond recuperation, two things happen. First, his whole industrial outlook is jeopardised and he becomes by rapid stages a liability and even a charge on the State. Secondly, if the bodily defence is undermined by stress and strain the man falls a ready prey to diseases such as tuberculosis. Therefore, as the problems to which reference is made in this Memorandum concern the future as well as the present, so also they are concerned with the new Preventive Medicine which has for its object the *removal of the occasion of disease and physical inefficiency, combined with the husbanding of the physical resources of the individual,* in such a way and to such a degree that he can exert his full powers unhampered at home or in the workshop, and with benefit to himself and all concerned.

Conclusion.

143. The scope of Preventive Medicine as set out above is concerned directly with the education of the medical student. It does not include

the special work and the particular study in the laboratory and otherwise which forms an essential part of the equipment of the public health specialist, the school medical officer or the medical officer of health. It deals only with the irreducible minimum of knowledge and understanding necessary to the general practitioner *if he is to serve the community satisfactorily and completely* as a practitioner. It may not have been necessary in the past, it is necessary now. For it is the lack of this equipment that has hitherto restricted the service of the practitioner. As we have seen, the future of Preventive Medicine depends in large degree upon the outlook, scientific temper, scientific method and rational practice of the general practitioner. No scheme of Preventive Medicine can be adequate or effective which does not use him as one of its principal agents, whether he be consultant, private practitioner or panel doctor. There must be no divergence between private practice and State Medicine, between curative and preventive medicine; rather must there be sympathetic understanding and close co-operation. The establishment of a Ministry of Health at the centre and the simplification or unification of Local Authorities at the periphery cannot of themselves solve the great problems of Preventive Medicine which lie before the nation in the immediate future.* There are three parties to such a solution, namely, the medical officer, the private practitioner and the people themselves. There must be, in fact, what Edmund Burke recommended, namely, a partnership—a great and new partnership, inspired by a wider and a deeper spirit. *And the student must be taught this.*

144. In order to obtain these things it is submitted that the authorities of the Universities and Medical Schools concerned in medical education should without delay give the most careful attention to the organisation of the teaching of Preventive Medicine; taking account of the large content and the sound organisation which is necessary to its effective teaching. There must, of course, be a certain number of systematic lectures combined with practical work and demonstration. But much more important will be the revitalisation of the whole subject of Medicine by the experimental, the scientific and the preventive spirit. For Preventive Medicine is not a subject which can be taught *ad hoc* or in a watertight compartment. Its purpose and its spirit should pervade the entire curriculum and system of Medicine—the Practice of Physic, Surgery, Obstetrics, Psychiatry, Pediatrics, and the other specialities, for they all need the inspiration of the true preventive method, yielding a deeper and a wider consideration of each patient.

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* The proposal to create a Ministry of Health is designed to secure a piece of administrative machinery for the purpose of facilitating more effective and co-ordinated working of the existing disconnected health departments of central and local government. Such a unification would presumably reduce the wastefulness and overlapping of functions, provide for the proper organisation of the public medical services and the earlier treatment of disease, associate together curative and preventive medicine, interpret and guide the newer conceptions of preventive medicine, and deal with national health problems as a whole rather than in the present piecemeal manner.

ADDENDUM.

Statement suggesting Scope of Preventive Medicine for the Medical Student.

145. The following statement is intended to be suggestive of the nature of the Preventive Medicine which should form an integral part of the warp and woof of the medical curriculum. Certain sections should no doubt be incorporated in the course of Hygiene for medical students; other sections should be included in the appropriate subjects of the curriculum, such as physiology, pathology, medicine, surgery or obstetrics, which in greater or less degree is the case at the present time in some Schools. The proposal is not to add a new subject, nor to lengthen the student's curriculum as a whole, nor even to inflate the subject of "Hygiene"; the essential point is that every medical student, before or after graduation, shall receive proper instruction in these matters (some of which are at present almost wholly ignored), and become imbued with the purpose, practice and spirit of Preventive Medicine. He must understand the preventive aspect of Medicine, Surgery and Obstetrics. The statement, which has been advisedly kept simple and elementary, is designed for the medical student and not for the student reading for a Diploma in Public Health. A consideration of the daily needs of the medical practitioner in ordinary practice in England or Wales will, it is submitted, be found to justify the contents of the statement, the subjects of which should be illustrated and taught, as far as practicable, by means of demonstration or example.

1. *Meaning and Scope of Preventive Medicine.*

   Relation to preliminary science, intermediate and clinical subjects of curriculum.
   Sphere of Private Practitioner, panel doctor, and public health official. Part played by layman.
   The natural history of disease.
   Principles and methods of Preventive Medicine.

2. *Administrative Machinery of Preventive Medicine.*

   (*a*) Outline of English System of Local Government as regards the relation of various Authorities, central and local, to the practice of Medicine.
   (*b*) Outline of English Sanitary Law and Institutions.
   (*c*) The Sphere of the Public Health Services in relation to general practice.
   (*d*) Legal obligations of General Practitioner. Notification and death certification.
   (*e*) Auxiliary officers: Midwives, nurses, health visitors, sanitary inspectors.
   (*f*) Arrangements for dealing with sick poor, aged and infirm, mental defects, cases of infectious disease, venereal, tuberculosis, &c.

3. *Maternity.*

   Ante-natal care. The Expectant Mother. The care of the Pregnant Woman.
   Sphere of doctor, midwife and nurse.
   Administrative Services: maternity benefit, maternity centres, maternity homes, lying-in-institutions, Schools for Mothers.
   Employment and maternity. Requirements of Factory and Workshop Act, s. 61.
   Poor law in relation to maternity.
   Safeguarding health of unborn infant.
   Birth notification. The problem of illegitimacy.

4. *Medical Care of Infancy.*

   The problem of infant mortality—definition, characteristics, distribution, age incidence of mortality, urban and rural, causes, conditions, prevention. Wasting and fatal Diseases of Infancy.
   Relation to physique and occupation of mother, to unsatisfactory infant feeding, to infant mismanagement, and to domestic insanitation and overcrowding.

Principles of infant welfare centres and schools for mothers.
The question of breast feeding and artificial feeding.
The Hygiene of Infancy, warmth, food, clothing, cleanliness, &c. Prevention of *ophthalmia neonatorum*, ear and throat troubles, dental caries, infectious diseases.

5. *The Young Child.*

Feeding and clothing of child (1–5 years); cleanliness; sleep; training of senses; weight, development, height.
Minor ailments: dental conditions, infectious diseases, indigestion. Preventive Methods.
Child-welfare centres: Baby clinics, crêches or day nurseries, "toddlers" playground, play centres, kindergartens.
The Nursery School.

6. *School Hygiene.*

Health requirements of children.
The beginnings of disease: signs, prevention.
Principal diseases of school life.
School Medical Service: objects and results, medical inspection and treatment, school clinics, dental clinics, the mentally and physically defective child, (blind, dumb, deaf, feeble-minded, epileptic), heart cases, tuberculosis, chorea, &c.
Special methods: the open air school, children's sanatoria, recovery schools, special schools.
School Feeding. Provision of Meals Act.
The dull and backward child.
Cleanliness: school baths.
Juvenile employment. Effects of fatigue.

7. *Personal Hygiene of Adolescent and Adult.*

The resistance of a healthy body a defence against disease.
Habits, food, exercise, sleep, baths, clothing, skin, teeth, organs of special sense.
The hygiene of the mind.
Adolescence, puberty, sex problems.
Physical Training, objects and effects, application of physiology to physical exercise, principal points in respective systems, remedial exercises, massage.

8. *The Dwelling House.*

Site, dampness, sanitation, sanitary conveniences, drainage (systems and relation to health).
Domestic insanitation.
Cubic capacity and ventilation. Composition of air, purity, temperature, and movement. Humidity, means of, through ventilation.
Overcrowding in relation to disease and mortality.
Lighting and heating.
Refuse collection and destruction.

9. *The Housing Question.*

General principles of house sanitation.
Insanitary houses and areas: characteristics.
Insufficiency of house accommodation.
Medical evils of the tenement system.
Relation of housing to disease and mortality.
Overcrowding of houses per acre and persons per room.

10. *Food Supply.*

Dietaries—calorie value, physiological value, quantity, quality, and nature of food.
Nutrition as condition of health and resistance to disease.
Food Poisoning—infections and intoxications. Meat poisoning, shell fish, pork, potted and prepared foods.
School feeding, outdoor relief, industrial canteens.

11. *Milk Supply.*

Value as food.
Conditions of milk supply.
Diseases conveyed by milk. Methods of prevention—channels of infection. Study of typical and illustrative epidemics. Characteristics of milk-borne disease.
Milk supply in relation to tuberculosis and child mortality.
Specialised milks, modified, condensed, sweetened, dried. Milk depôts.
The Control of the Milk Supply—production, purity, distribution.

12. *Water Supply and the Public Health.*

Quantity of water required for personal health.
Sources, pollution and purification. Filtration (municipal and domestic), chemical treatment, boiling.
Water-borne disease: characteristics Study of typical outbreaks. Means of prevention.

13. *Alcohol and Alcoholism.*

Alcohol: its use; its effects on mind, on muscle, on stomach and digestion, on respiration and circulation, on body temperature.
Poison action of alcohol: intoxication, degeneration, delirium tremens, insanity.
Alcohol in relation to longevity and mortality.
Accidents, suicide and crime.
Industrial, dietetic, and convivial drinking.
Social and medical causes of intemperance.
Diseases produced by excessive consumption.
Clinical character of alcoholism. Treatment.
Means of Prevention—abstinence, licensing, taxation, restriction, prohibition.
Effect of Liquor Control Board restrictions on disease and mortality.

14. *Infection and Infectious Diseases.*

History of Contagium vivum.
The Germ Theory: the etiology of disease.
Channels of Infection (contagion, water, milk, lice, mosquitoes, &c.).
Course of Infective Diseases: atypical forms, signs and characters.
Causes and conditions: means of prevention of occurrence, of spread, of mortality.

(1) Small-pox, and chicken-pox.
(2) Measles.
(3) Enteric, dysentery, paratyphoids.
(4) Typhus.
(5) Epidemic diarrhœa.
(6) Tuberculosis.
(7) Epidemic pneumonia.
(8) Diphtheria.
(9) Scarlet Fever.
(10) Cerebro-spinal fever and poliomyelitis.
(11) Venereal. Syphilis and gonorrhœa.
(12) Influenza.
(13) Tropical disease, *e.g.*, malaria.
(14) Trench Fever.

Methods of Prevention to be exercised by practitioner, by sanitary, education and poor law authorities.

15. *Principles of Epidemiology.*

Factors in epidemicity.
Means of spread: water, milk, contagion, "carriers," contacts, parasites, vermin.
Periodicity and cycles.
Methods of inquiry and investigation in household.
Immunity: principles and methods.

16. *Diseases of Animals Communicable to Man.*

The inter-relation of disease in plants, animals and man.
Tuberculosis, anthrax, rabies, tetanus, glanders, parasites, &c.
Trypanosomiasis, ankylostomiasis
Means of communication—lice, fleas, insects, mosquitoes, rats, cats, birds, horses. Animal immunities.
Methods of prevention.

17. *The Prevention of Infective Diseases.*

(i) Notification. Aids to diagnosis. Bacteriological examination. Methods of early diagnosis. Administration of Notification: diseases which are notifiable.

(ii) Isolation—at home or in hospital (kinds of hospital available). Methods and effects. Management of a Fever Case.

(iii) Disinfection—methods, materials, and effects; fallacies of.

(iv) Special methods for dealing with expectoration, contacts, carriers, water and milk supply, rats, mosquitoes. School epidemics, sanatoria, farm colonies, &c.

18. *Vaccination and antitoxin inoculation.*

Small pox, typhoid, streptococcal infection and diphtheria as types.
Serum-therapy—(*a*) prophylactic; (*b*) therapeutic.
Vaccines—manufacture, dosage, use, effects.
Antitoxins—preparation, dosage, use, effects.
Vaccination Acts. Revaccination, limitations of protection.

19. *Prevention of other Forms of Disease.*

Methods of prevention of "non-infectious" disease, *e.g.*, Heart Disease, Pneumonia, Alimentary Disease, Colitis, Duodenal Ulcer, Food Poisoning, Rickets, Scurvy, Dental caries, Blindness, Rheumatic Fever, &c.
Evidence of conditions and influences leading to these diseases.
Relation of early neglect in childhood and adolescence to subsequent disease: dental decay, adenoids, anæmia, malnutrition, measles, tuberculosis, &c.
Social habits and avoidance of conditions leading to these diseases: dietetics, alcoholism, industrial strain and fatigue, venereal conditions.
Kinds of Strain in modern life and their effects.
Preventive work of Surgery: prevention of spread of infection (sepsis, tuberculosis, cancer); of disablement and deformity (fractures, surgical repair, tumours); of sequelæ (adenoids); of impaired function (eye, ear, nose, throat, nervous system, alimentary, respiratory and urinary tracts); of mortality.
Relation of asepsis and antisepsis to preventive medicine.

20. *Vital Statistics.*

Census, population.
Marriage rates, birth rates, death rates: types and methods of calculation; effect of ante-natal and social influences on birth rate; the illegitimate births.
Circumstances affecting Death rate: causes of decline; relation of environment and occupation. Certification of death.
Zymotic and occupational death rates.
Sickness rates.

21. *Health Insurance.*

Relation to medical practice, contract and private.
Benefits: medical, sanatorium, sickness, disablement, maternity and additional.
Approved Societies and insurance committees.
Conditions of panel practice: what is required of the panel doctor. Forms, ways and means. "Excessive sickness." Special treatment. Relation to hospital.

22. *Nuisances and Dangerous Trades.*

Definition and character of nuisances.
Effects on health: means of prevention.
Dangerous occupations: dust, lead, mining, metals, chemicals, fabrics, T.N.T.
Offensive trades: effect on health. Smoke abatement.

23. *Industrial Hygiene.*

Diseases of occupation.
Industrial fatigue and sickness. Relation to patient's employment. Eye injuries. Causes, conditions, effects, prevention.
The certifying factory surgeon.

Employment of women and young persons.
Industrial welfare and health efficiency. Hours of labour, shifts, spells, &c. Sunday labour and night-work. Washing facilities, baths. Seats, special clothing. Provision for sickness and accident (aid-posts and surgeries). Protection of eyesight. Industrial canteens. Welfare supervision. Healthy factory environment.

24. *Medico-Sociological Questions in relation to medical practice.*

The position of the Medical Profession: its governance and control. Brief sketch of its history. Relation to other professions.
The State and the Doctor. State hospitals.
Labour and its conditions in relation to sickness.
The Problem of Poverty. Pauperism in relation to disease.
Wages and the cost of healthy living.
Health and Education.
Crime, insanity, inebriety, suicide: their relation to disease.
Vivisection. Social immorality. The venereal problem.
Old Age Pensions, Army Pensions.

SECTION XII.

THE PLACE OF RESEARCH IN MEDICAL SCHOOLS.

146. The spirit of investigation has always been vigorous in English Medicine, though passing circumstances have sometimes tended to conceal or even dispel it. In the sixteenth century Wootton and Caius, the contemporaries of Vesalius, set an example which was widely followed in the seventeenth century, but whilst they laboured at biology and the elementary foundations of medicine the workers in the succeeding century devoted their attention to morbid anatomy, to physiology and to the clinical aspects of disease. Harvey, Glisson, Sydenham, Willis, Lower, Mead, the Hunters and Jenner form a galaxy of field workers who inspired the laboratory men of the nineteenth century. It is important, however, to recognise that English Medicine and Surgery advanced for two hundred years outside the laboratory, in observational, experimental and clinical research work. Then came the great laboratory period of the last three or four generations, wisely intermixed with clinical study and post-mortem findings. Occasionally in recent times there has seemed to be evidence that the laboratory dominated and even excluded such field work, but on the whole the scientific medical mind in this country has manifested a happy equipoise of experimental and field work, of laboratory and clinical experience.

None can study the growth of English Medicine without observing the ebb and flow of the research spirit and its dependence upon a variety of social as well as medical factors. Two clear lessons, however, emerge. First, the spirit of research has proved itself to be the very breath and being of all true medical progress. When it has been in the ascendant the science and art of medicine have prospered and expanded; when it has declined or been in abeyance they have come to a standstill. This is true if we view Medicine as a whole, but it is equally true if we make an intensive study of the great practitioners and the great builders themselves and even of the Medical schools in which they worked. Whenever we are able to take a long view of a personal reputation or of the influence, credit and contribution of a School, the same meaning becomes clear, that where the spirit of research is alive and active there, soon or late, great advance is recorded.

A second fact is the predominance until quite recently of clinical research. The fact is that all sound clinical work *is* research (though not all research is clinical), and there is no greater mistake than the assumption that research spells only labour with test tubes, petri dishes, serums and guinea pigs. For many centuries the physician was, at his best, an observer only. Then at the Renaissance he caught the spirit of inquiry from Harvey, Descartes, Boyle, Hooke, Mayow and Sydenham, and following more and more the experimental method he found himself with new means to his hand, namely, instruments of precision, experimentation added to observation. The instruments of precision extended the use of his eye and hand, the experimental method tested and controlled his findings—the variation of one factor, then of more than one factor, then of repetition, and lastly of control

and counter-control, with quantitative data as a result. Our modern knowledge of disease has arisen largely through such clinical studies of the character, conditions and variations of rickets, diseases of heart and lungs, the course of fevers, plague, small-pox, tuberculosis, cerebral pathology, brain surgery, the treatment of wounds, and experimentation with anæsthetic drugs. There is no more inspiring chapter in the history of English Medicine than its record of clinical research, a record which contains, even in our own day, many of the greatest names of the profession, Jenner, Paget, Hutchinson, Hughlings, Jackson, Nettleship, Bowman, Lister and Horsley, and a number happily still with us.

147. But something more was necessary. When Mr. Lloyd George devised his Scheme of National Health Insurance he introduced no wiser or more far-reaching provision than that concerned with Medical Research. The conception of a national organisation of research and the means to establish it and carry it on has already justified itself abundantly. Four years ago the Medical Research Committee was appointed, and its annual reports record large and interesting achievements of the highest national importance.* The arrangements of the Committee comprise two general methods of attack on the illimitable region of the unknown. First, the Committee possesses its own Central Research Departments of (*a*) Bacteriology, (*b*) Bio-chemistry and Pharmacology, (*c*) Applied Physiology, (*d*) Statistics, and (*e*) Clinical research. Attached to each of these departments is an expert staff wholly engaged in prosecuting, in special laboratories, the work allocated to it by the central body. Secondly, the Committee has devised a Scheme of work being undertaken by competent workers in well-equipped laboratories in all parts of the country—in the universities and medical schools, in general and special hospitals, and in research laboratories. By this dual arrangement the Committee has become a central co-ordinating agency for the advancement of medical knowledge throughout the country.

148. The actual work of the Committee is no less comprehensive than its administration. There is hardly a subject affecting the daily health of the population, domestic or industrial, which does not come within the purview of the Committee and its staff. It began with tuberculosis of the adult, its causes and treatment; it went on to investigate rickets of the child; it made research into the urgent question of a hygienic milk supply; it inquired into the disabling diseases of the heart and nervous system; it penetrated into the workshop and sought to shed light on the problems of industrial disease. When the war came the Committee promptly applied itself to many new and pressing problems which presented themselves, and which interfered with military efficiency or prevented the speedy recovery of the sick, wounded, and disabled. First, the Committee became the headquarters of the Army Medical Statistics, indexing the casualties and sickness, and thus providing reliable means for checking pension claims, and furnishing data for an adequate medical history of the war. Secondly, the

* The Committee at present consists of the Hon. Waldorf Astor, M.P. (Chairman), The Right Hon. Christopher Addison, M.P., Mr. C. J. Bond, F.R.C.S., Professor Bulloch, F.R.S., Dr. A K. Chalmers, Viscount Goschen, Professor F. G. Hopkins, F.R.S., Sir W. Leishman, F.R.S., Professor G. Murray, and Sir W. M. Fletcher, K.B.E., F.R.S. (Secretary).

Committee have undertaken an immense burden of pathological work in connection with military problems, partly by instigating and encouraging individual and "team" inquiries at home and abroad, partly by special committees of experts (on surgical shock, air problems, war nephritis, chemical questions, &c.), and partly by pathological work at hospitals. Thirdly, a number of investigators have devoted themselves to the proper antiseptic treatment of infected wounds of the battlefield, and attention has been given to trench fever, gas-poisoning and gas-gangrene, trench foot, irritability and other disorders of the soldier's heart, gunshot wounds, functional nervous maladies, disinfection of hospital ships, cerebro-spinal fever, dysentery, paratyphoid, and other epidemic diseases of military camps. Nor has the health of the munition worker or T.N.T. poisoning been forgotten or passed over. The wideness of the survey undertaken indicates a proper appreciation of the sphere of a body maintained by public monies and having a comprehensive purpose to fulfil. This feature, combined with a co-ordinating administration, has made the work of the Committee of the greatest national value. The very difficulties of the war situation—loss of trained laboratory attendants by enlistment, the scarcity of apparatus, the pre-occupations of war—may yet prove sources of strength by increasing the demand for *initiative*, *application* and *invention*, three of the prime necessities of all true research, and by furnishing new *opportunities* for investigation. The inclusion of an increasing number of women research workers is also full of promise. Future years alone can prove the strength and soundness of the foundations now being laid, but there is every indication that both foundations and superstructure will be entirely creditable to the foresight of the promoters of this Scheme for the application of the scientific method.

> "The Committee believe that in retrospect they can trace throughout the war a steady growth in the recognition given everywhere to the value of medical research work and its necessity for efficiency wherever the human machine is to be used and controlled by human minds. In the early stages of the war, while our deficiencies due to our former failures to encourage or to apply the work of science were widely deplored, it was very common nevertheless to hear that research should be laid aside 'till the war is over.' Bitter need in every direction of the contest, and not least upon the medical side, has shown how vital the spirit of inquiry is to success in this prolonged competition of national efficiencies. . . . What the results of this scientific work in the medical services have meant in terms of life and treasure already saved can never be known, nor can we guess at the losses due to our previous national neglect of investigation. We cannot calculate in set terms the value either of knowledge as such, or of the saving of life or the reduction of suffering. If only the narrowest commercial view be taken, the monetary gain is seen to be vast."*

149. The student of this beneficent and constructive movement may be surprised to find important features conspicuous by their absence, though the responsibility for the absence cannot be laid, in any degree, at the door of the Medical Research Committee. In the first place, there is little sign that the general practitioner, with some brilliant exceptions, is taking any substantial share in the work of investigation. This is, perhaps, inevitable; it is due partly to lack of opportunity and the immense pre-occupations of practice, and partly to

* Third Annual Report of the Medical Research Committee, 1916–17. (Cd. 8825)

lack of the research spirit. Some way ought to be found for facilitating research work by practitioners if and when practicable, for they have a sight of the disease process often hidden from the specialist; but broadly the defect is one of training and lack of opportunity. Secondly, it is significant that the larger part of the new knowledge (as distinct from medical and surgical practice) obtained in the last five years has been furnished by the pathologists, physiologists, and laboratory workers, and not by the clinicians. The rapid growth of knowledge, the ever-increasing absorption in active practice of the leaders of the profession, and the subtle allurements of riches and honour—all marks, be it noted, of success—have not seldom exerted an unfavourable effect on the clinical workers' devotion to research. Unfortunately for the cause of truth and new knowledge, he finds the broad way of practice brighter with prospects of social distinction than the narrow path of hard and toilsome investigation. Then there is a third feature which calls for more consideration than it has received. The teachers in the Medical Schools are not the principal workers in research. Yet teaching and research work are twin brothers. *He only is the great teacher who is inspired by the spirit of discovery*, for he only can hand on the torch to his disciples. A peregrination of a score of Medical Schools in England will convince any impartial observer that the separation of teaching and research in these Schools is death to all that is best and most promising in their future. If we continue to disregard and overwork and under-pay our teachers of preliminary and intermediate medicine, and if we continue to be content with the residual or "fag-end" of our clinicians best educational endeavour, then we not only do irreparable hurt to our educational institutions, but we obstruct and prevent the growth of knowledge itself. *For the fountain of research is the School of Medicine.* If our teachers be without imagination and without the spirit of discovery—or having these faculties be so cribb'd, cabin'd and confin'd by restrictive conditions that they are without opportunity for their exercise—then our students will fail to drink of the deep springs of Learning now, and in the future will fail to yield the fruit the nation has reason and right to expect of them.

150. The conclusion of this matter seems to indicate that there must be, in future, a more intimate association between teaching and research on the one hand, and between laboratory research and clinical research on the other. Time should be found, and money and opportunity provided, and the faculty of research should be one of the qualifications for appointment on the teaching staff. For "it is a necessary condition of the work of University teachers," said the Royal Commissioners on University Education in London in 1913, "that they should be systematically engaged in original work." It is difficult to see how these conditions can be furnished apart from (*a*) some reorganisation of the intermediate teaching in the Medical Schools, (*b*) the appointment of clinical professors whose main life-work is research and teaching, and (*c*) with whom shall be associated competent assistants and suitable equipment.

SECTION XIII.

THE STUDY OF MEDICINE AFTER GRADUATION.

151. There are two broad grounds for the introduction of systematic "post-graduate" study in Medicine. The first is the rapid advance in the science and art of Medicine, which places the practitioner of a few years standing at a disadvantage, particularly in view of the new claims continually and properly made upon him; the second is the overcrowded state of the medical curriculum. It must be borne in mind that within the last ten or twenty years substantial additions, amplifications and improvements have been introduced in the student's course of Medicine with a view to bringing the curriculum into accord with the numerous inventions and discoveries of recent years, and this is a change which cannot fail to recur periodically. New drugs, new applicances, new methods of diagnosis and treatment, new means of prevention, new applications of old principles continually arise, and the post-graduate worker in whatever branch, and wherever located throughout the British Empire and its Colonies, is in great need of assistance to refresh his faculties, to revise his methods, and to extend his knowledge. The immense expansion of the course of undergraduate study only serves to give emphasis and urgency to this plea. A five years' course can after all only furnish the diligent and intelligent student with a sound grounding in the essentials of medical learning. Without *experience* and without *practice* the superstructure of technique and wider knowledge upon which effective practice depends cannot be built, however broad based and well laid be the foundations. There is profound good sense in the German plan of requiring an internship in the last year of study, and in the English plan of resident hospital appointments immediately after qualification. But at present this is practicable only for few and exceptional students. What is required is some arrangement by which—

(*a*) all students shall receive special post-graduate training of one form or another before embarking upon practice (preferably in resident clinical appointments in general or special hospitals, poor-law infirmaries, dispensaries, &c.), and

(*b*) all practitioners shall find facilities available for periodically bringing their knowledge and practice up to date.

"One of the greatest drawbacks of all," said a successful and experienced general practitioner the other day, "is that medical men "waiting for practice have absolutely no facilities for carrying on or "extending their medical study." That is the need in all parts of the country of the young practitioner and still more so of the older men. They desire, and they require, every few years to bring themselves up to date, sometimes in all branches of their work, sometimes in special branches. There are medical officers of the Army, the Navy, the Indian and Colonial medical services in the same dilemma; there are also graduates from the Colonies, from the United States and from the countries of the Allies conscious of a similar need.

152. A consideration of these matters makes it necessary to design schemes of post-graduate teaching and learning of various degrees and kinds, as follows:—

(i) Post-graduate instruction which forms an integral part of the curriculum of the ordinary Medical School, combined with widely increased opportunity of clinical appointments.

(ii) Similar instruction in special subjects at *ad hoc* Schools and hospitals for diseases of women and children, neurology, skin disease, orthopædics, psychiatry, eye, nose and throat and other specialities crowded out of the ordinary curriculum.

(iii) Post-graduate work at local town and county hospitals (military or civil) in different parts of the country for additional training, in both general and special medicine, of the local medical practitioners of the district.

(iv) An imperial post-graduate teaching scheme in London or elsewhere for foreign and colonial graduates who formerly repaired to such centres in Germany and Austria, and which would serve both as a teaching centre and as a "clearing house" and central bureau to advise appropriate courses of study and facilitate their provision.

It is clear that the character of central courses would necessarily differ somewhat from those attended by private practitioners in local areas. They would be more varied, general and comprehensive in nature, and probably shorter and more concentrated in form (occupying, say, whole time for one to three months). The private practitioner usually requires opportunities which do not take him from his practice for more than a few hours and which afford him the occasion for study in subjects directly concerning his practice. The visitor from abroad comes for a few weeks or months and desires to concentrate his study, (*a*) in following the practice of some particular Medical School, (*b*) in specializing in one or more relatively narrow subjects, or (*c*) in observing the methods and work of some eminent exponent of medicine, surgery, gynecology or tropical disease. We are not lacking in such eminent exponents; we are lacking in organisation. We do not avail ourselves of the services of distinguished authorities in an effective way. The opportunity is wasted or lost. There can be no question that with appropriate arrangement post-graduate centres of the greatest value could be established to bring English and foreign students to the highest teaching authorities: Sir Clifford Allbutt at Cambridge, Sir William Osler at Oxford, Sir Wilmot Herringham at St. Bartholomew's Hospital, on medicine; Sir David Ferrier or Dr. Henry Head, of the London Hospital, on neurology; Dr. Griffith, of Leeds, Sir James Mackenzie or Dr. Lewis on heart disease; Sir Almroth Wright on serum therapy; Sir Arbuthnot Lane, Sir Berkeley Moynihan, Sir A. Bowlby or Professor Rutherford Morison, on surgery; Sir Ronald Ross or Sir W. Leishman on tropical diseases; Sir Robert Jones, of Liverpool, on orthopædics; and an exceptional group of masters of the intermediate subjects: Sherrington, Starling, Halliburton, Elliot Smith, Keith, Andrewes, Woodhead, Dixon, Dale, Cushny, Herdman, Dendy, Sir E. Rutherford, and others; and there are exponents of industrial hygiene and preventive medicine, of

obstetrics and gynecology, of military hygiene and diseases. After all, it is the great teacher and the great investigator who draws disciples, and not the successful consultant; and therefore here, as elsewhere, it is men and not institutions which are the real pivot of the work. It would be the purpose of any central scheme to provide for the varied needs of candidates and direct them to this or that teacher or institution able to meet their requirements; sometimes for general attendance at a given hospital, sometimes for a one, two or three months' laboratory or clinical course; and sometimes for a whole-time clinical assistantship. This will naturally involve the organisation of clinical study, the proper co-ordination of means to ends, and the mutual co-operation of the general and special hospitals, the London and provincial Medical Schools, and the post-graduate scheme of study. Such a scheme would also incorporate other existing centres of post-graduate study.

(i) *Subjects of Study.*

153. Whilst the post-graduate study of Medicine may be expected to evolve in different ways, and in accordance with demand, it is extremely important that the recognised Medical Schools should without delay seek to organise a comprehensive scheme of tuition which will be likely to meet the needs of the situation of the general practitioner in England, at an early date. Their first teaching duty is to their own students and post-graduates; if that be organised satisfactorily, it will by relatively small modification provide facilities for practitioners or medical officers from abroad. Three points should receive attention in the consideration of such organisation. First, there are the subjects of study. The general practitioner needs most of all a revision course in diagnosis and treatment—subjective symptoms, physical signs, the use of instruments of precision, laboratory tests, radiography, and clinical opinion and judgment—special tuition in tuberculosis and venereal disease, the detection and management of early mental cases, differential diagnosis in surgery, disorders of digestion, ophthalmology*, and the great group of conditions known as "war neuroses." For example, in regard to *tuberculosis*, medical students and practitioners should be afforded increased facilities to attend the practice of dispensaries, sanatoria, hospitals and other institutions for dealing with the disease. It is of great importance that the appointment of Tuberculosis Officers under the local sanitary authority should not remove or lessen the responsibility of the practitioner and his equipment to deal with this disease. A post-graduate course should include the consideration of pathological, clinical and preventive aspects of the problem—the life history of the bacillus, determination of its presence, immunisation, morbid anatomy, newer clinical methods, prognosis, and the working of the dispensary, sanatorium and colony system. Again, *psychiatry* is a subject in which both the student and the practitioner need instruction. The General Hospitals do not make provision for the treatment of mental diseases, cases of which are referred to the Poor Law Authorities for temporary care or to asylums for custody. Even in the case of patients who can afford to pay for maintenance, there are civil disabilities which usually

* *The teaching of Ophthalmology* by A. Maitland Ramsay, M.D., 1914.

preclude early treatment. Yet facilities for *early* treatment are most urgently needed all over the country, for at present neither treatment by private practitioner or institution is available. Little or nothing is to be gained by the practitioner receiving intermittent instruction at asylums. The solution seems to be the establishment in connection with medical schools and hospitals of special clinics for mental disease, as in Germany and America (as at University College Hospital, and Guy's), and particularly for early cases, with and without beds. Such centres could be used for treatment of such cases, for instruction of students and practitioners, for the remand of doubtful and criminal cases, for study of social conditions affecting lunacy, and for investigation. It is deplorable that the English student of medicine should have no opportunity of learning anything of modern methods of psychiatry or of diagnosing incipient and undeveloped cases of mental disease. Once more, post-graduate *surgery* is largely a neglected field of teaching. Yet the practitioner requires revisionary instruction in the treatment of fractures and dislocations, in the newer methods of wound treatment, in diseases of the eye, ear, nose and throat, in the differentiation and management of abdominal emergency, urinary disease, neuroses and malignant conditions.

(ii) *Convenient Facilities.*

154. Secondly, in organizing post-graduate study for the practitioner the arrangements must allow for tuition apart from the ordinary medical student, for an appropriate association of laboratory and clinical work in the courses proposed, and for the facilities provided to be conveniently accessible in respect of time, place and fee. In the past the practitioner has not responded to the intermittent provision made for his further instruction because these three points have not been sufficiently regarded. They involve a local organisation in counties or similar areas, *associated with the local hospital*, to which greater access should be obtainable by practitioners of the district, at which clinical demonstrations and conferences should be held by the staff (or visiting consultants or practitioners), not on exceptional or curious cases, but on the ordinary patients, on routine autopsies, and on clinical laboratory methods. Such hospitals should also become organised centres for providing clinical, bacteriological, pathological and radiographic facilities for the practitioners of the neighbourhood. A local hospital library and museum will add to the interest and value of such work. Useful work of this kind has been carried out at Newcastle-on-Tyne, at Cambridge, at Sheffield, and at other medical schools and hospitals.

(iii) *The Conduct of the Course.*

155. Lastly, attention must be given to the principles governing the conduct and character of post-graduate courses. They must be comprehensive, reasoned and considered, and taken by students able to appreciate, understand and apply the teaching given. The quality of the work should reach University standard in respect of the teaching staff, the syllabus, and the sustained character and homogeneity of the treatment of the subject. Perfunctory, irregular or merely didactic instruction will fail, as it deserves. Above all, such courses must be practical, providing each student with an experience which is valuable

to him in the better discharge of his professional duty. There are now medical schools in London and at Oxford, Cambridge, Birmingham, Bristol, Liverpool, Manchester, Leeds, Sheffield, Newcastle and Cardiff, and facilities for clinical instruction at another score of populous centres. What is necessary is the organisation of all the clinical work thus represented in behalf of thousands of medical practitioners, having its local centres in well appointed hospitals, laboratories and clinics (general, county, cottage, military, poor law, women and children's hospitals, and tuberculosis, venereal, orthopædic and school clinics, &c.).* The benefit accruing to the practitioner and to the hospital system by such a scheme of co-operation is difficult to overestimate, for its immediate effect would be better treatment for the patient and improved medical education.

156. The fact is that owing to lack of foresight and organisation incredible waste and loss of opportunity is going on in regard to this question. The nation badly needs all the best medical work, both treatment and research, and all the best medical education which is, or can be made, available. A great part of the population are submitting themselves to medical treatment by professional men trained 20 or 30 years ago; it would handsomely repay the State to encourage and to aid fresh study every eight or ten years, so rapid and profound are the advances in medicine. Such post-graduate study can only find its true source in the medical schools or in their teachers; it cannot be firmly established or fulfil its purpose apart from a sound system of medical teaching.

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* *See* Report of Departmental Committee on Tuberculosis, 1912, p. 16.

SECTION XIV.

CONCLUSION.

157. The present position and needs of medical education in England, the character of university teaching, and the principal articles of content of the medical curriculum have now been briefly considered. The product or fruit which is desired is a practical, well-educated and properly equipped medical man, one in whom there is combined, as Sir Clifford Allbutt says, "both real and practical education, who is "armed with technical dexterity, versatility and resource, as well as "illumined by the ideas and guided by the mental and imaginative "discernment which are born of a large, deliberate and inventive "education."* On the whole, and on a balance of considerations, it may, I think, be said that the English system of education, whatever be its faults and limitations, is furnishing this product better than any other system. There is no occasion for revolutionary changes; there is occasion for continual watchfulness, continual adjustment and adaptation of means to ends, leading to continual advance. But such progress must not be permitted to entail an ever-increasing burden upon the student. If there is one thing more certain than another it is that the student of medicine is overworked and overburdened. There is insufficient opportunity for mental assimilation, for maturing faculties, or for wide and widening conceptions and experience. "For two "generations," it has been truly said, "we have been loading and "loading this brief curriculum as if our ambition were to teach many "things ill rather than a few things well. And we have seen how one "may spend a life-time on many acquirements and yet be uneducated. "Our forefathers thought, and I agree with them, that the backbone "of medical education is anatomy; that the right way to educate is to "teach a few subjects broadly and deeply; and that the right way to "build is to begin with the backbone."† Hence there must be from time to time, and in accordance with the direction and establishment of new medical knowledge or the requirements of the times, reasoned effort to eliminate the unnecessary and the redundant and to concentrate on the essential things, always bearing in mind that the object of medical education is not the completely furnished encyclopedic but the equipped man, alert, ready, trained, with an expanding and enlarging mind, the dexterous and willing instrument of knowledge, technical craft and progress, whatsoever its destination. We may well reduce the data of botany and chemistry and begin the preliminary science earlier; we may strip the study of anatomy and physiology of useless memorising of unimportant detail; we may abolish a considerable amount of materia medica and some pharmaceutical work; we may diminish the number of systematic lectures in almost all directions; and we may bring tutorials and our examination system into subjection. This would greatly reduce the burden and alter the context of the curriculum. All through the curriculum we need to impose less on the memory of the student, and seek rather to draw out his mind and faculties, his interest and perception, compelling him by a *vis a fronte* to do things for himself with his own hands

* "On Professional Education," 1906, p. 45. † Loc. cit., p. 51.

and his own head, to observe and experiment, to study intensively rather than extensively, to think and wonder and investigate for himself. This is to educate him and give him independence, to add experience to knowledge and wisdom to experience, and above all to foster the love of learning.

158. Thus, while we reduce and simplify the curriculum, we must seek to make it the machinery of a deeper study and a more effective training than heretofore. First, it must always be strong in anatomy, physiology and pathology, the bed-rock of Medicine. Secondly, the student can never afford to neglect or be superficial and careless in regard to a thorough training in physical signs and clinical examination. No new inventions or methods, no instruments of precision, can absolve him from the duty of his own senses in this matter. He must know his way about the body completely, and no book learning can give him this. Thirdly, there should be much more concentration on the out-patient department, on children's ailments, and on subjective symptoms, and any mode or device which will bring the student into immediate and personal touch with *the beginnings of disease.* It is vastly more important that he should know by practice and experience about malnutrition, anæmia and early disorders of the heart, the initiatory signs of dyspepsia, the bronchitic, rheumatic or tubercular diatheses, measles, mental failing, the incipient stages of the exanthemata, the subjective symptoms of disease, minor surgery, and what is and what is not sound obstetrics, than that he should know all about the mysteries of melanotic sarcoma, sequestration dermoids, cancer of the gall bladder, tumours of the bones, or all the stages of cesarean section or the operation of excision of the upper jaw. Fourthly, more attention seems to be needed to the whole question of therapeutics, both the purpose and means of medication and the wider therapeutics, which are non-medicinal. Fifthly, and associated with treatment, is the large issue of preventive medicine, in which something approaching revolutionary reform is needed. The ordinary medical student does not require a course of study comparable to that prescribed for the Diploma in Public Health. He is not a "diminutive" medical officer of health. The knowledge of preventive medicine he requires is something deeper and more intimate than an administrative function or dealing with an environment, more innate than a collection of memorised data; it is such an understanding of the nature of disease that its occurrence can be prevented or it can be checked in the patient before disablement, in short, a curative medicine which is preventive. Its application is not restricted by law or confined by expediency; it is universal. It concerns almost all disease, and not infectious disease only. To express it crudely, death under 50 or 60 years of age has got to be prevented or avoided, and the medical practitioner is the primary agent in the task. The sixth principal thing needed in medical education is the provision of appropriate graduate (or post-graduate) training, with facilities for an actual experience in medical and surgical treatment and obstetrics.

The Defects of Medical Education.

159. The previous paragraph reviews, by way of summary, the characteristic requirements of a medical curriculum. A brief paragraph should be added as to principal defects which have impressed

me in my work as Medical Assessor during the last few years. I have already recorded my conviction that the best English medical teaching need not fear comparison with medical teaching elsewhere. We desire in honour to prefer one another, and we have much to learn in this country from our kinsmen in America and from our colleagues in Europe; but we have in this Kingdom a great history and a great tradition of Medicine of which we are heirs. In what do we fail? Setting on one side, as outside the purview of this Memorandum, the defective preliminary training in general education in the Secondary School and the examination system for medical diplomas and degrees, and restricting the estimate therefore narrowly to the medical curriculum, there appear to be four main things lacking:—

(i) *There is too little medical teaching of university standard*, especially in the final or clinical subjects. This is partly due to the pre-occupation of the clinical teachers, partly to lack of method, partly to a system of "spoon-feeding," or "cramming" to meet the insistent demands of an examination, and partly to insufficient teaching equipment and accommodation. Moreover, eminently successful physicians and hospital surgeons of long standing and deservedly high repute are not always equally competent as educationalists. Yet a University is a place of education, and teaching which is "good enough" is never good. "The clinical teaching of the Universities," said Mr. Flexner, "is not "university clinical teaching, nor is it of modern clinical "type."* This seems a hard saying, but it is true of not a little of the clinical teaching conducted in this country. Happily, there are brilliant exceptions, and our aim should be to provide conditions which will make those exceptions the rule; and it is no reflection upon the Examining Bodies to add that "the ultimate reliance for ideals and intelligence "must be *on the schools as such*, and not on the schools acting "under the coercion of Examining Bodies."†

The principal means of remedy would seem to include (*a*) the elimination from the curriculum of unnecessary burdens and the readjustment of its contents, with appropriate postponement to a post-graduate stage of some of the teaching in specialities; (*b*) a fuller recognition of the growing and vital aspects of the intermediate subjects; and (*c*) a reorganisation of education in clinical medicine and surgery (as suggested in Section IX., para. 111 of the present Memorandum) and the provision of modern equipment for teaching these subjects adequately (clinical laboratory accommodation for the bacteriology, chemistry and pathology of the ward, radiographic and electrical appliance, and convenient arrangements for instruction in massage, remedial exercise, hydrotherapy, &c.).

(ii) *There is insufficient co-ordination between subjects and departments.* If a stranger enters one of our Schools of Medicine he will discover many highly competent teachers and

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* *Medical Education in Europe*, 1912, p. 303. † Loc. cit., p. 283.

some well-equipped departments, but a cursory examination may reveal the fact that all too frequently they are self-contained. The Professor of Physics may have never visited the Physiological Department, though he prepares his students for it; the Professor of Chemistry is a stranger to the Pathological Department, though his science is every day gaining ground there; the Professor of Physiology may be unaware of the practice and scope of the Anatomical Department; the teacher of Clinical Surgery may be innocent of any exact knowledge of the educational arrangements of the University he serves; the Professor of Pharmacology, if there be one, is not in touch with the clinical teachers, and in their courses they do not include any adequate instruction in the application of his work; or the physicians and surgeons do not always confer. In other words, a system of isolated and detached compartments too frequently obtains. Yet biology, physics and chemistry are together the foundation of the intermediate subjects and pathology, even as they, in their turn, are the essential preparation for clinical understanding and training. The student is not sufficiently taught that the advanced subjects *consist of* biology, physics and chemistry applied to the life, form and function of the body in health and disease. The patient *is* a case of anatomy, of physiology and of pathology to be interpreted and treated on grounds and by means which are in essence chemical, physical and therapeutic. The examples of this truth are manifold. Physiology, as we have seen, must be brought into touch with the elements of clinical study—the physiology of the mammal and of man, its application in the clinical laboratory and the ward, and above all the recognition of the immense part played by the organic regulation of structure and activity, which the wise physician and surgeon seek not to destroy or pervert, but to release, to aid and to supplement at the bed side. Any lack of co-ordination of subject and of method, and still more of scientific spirit, is not peculiar or confined to the United Kingdom, but it is harmful and mischievous. There should be close co-ordination and frequent personal co-operation within the Faculty of Medicine, between laboratory and ward, *and also between all Medical Schools*, in order that medical education throughout the country may be at least as well organised as the Examination System has been. The urgent need in Medicine at the present time is this association of the different parts of medical science both in relation to each other and to clinical practice. The effective conjunction is the co-ordination of the hospital function with the educational function.

(iii) *The association between medical education and medical research* is of paramount importance to both, but only a beginning has been made. The organisation of research at several of the Medical Schools by the Medical Research Committee

is a most hopeful sign of progress, but it requires wider application and a closer integration with the actual teaching work. It is not sufficient for research work to be done *at* a Medical School, the whole method and spirit of research must enter into the life of the School, inspiring teachers and students alike.

(iv) *Lastly, the post-graduate study of Medicine calls for organisation*, in order that subsequent to graduation the medical student may continue his studies in some resident hospital appointment or otherwise, and the practitioner of some years' standing be able periodically to refresh and extend his knowledge and improve his practice. In this way the study of certain specialities now overloading the ordinary curriculum may be more adequately and conveniently provided for.

160. When we turn to consider what remedial action should be taken to meet these four principal defects, two fundamental necessities emerge. First, there is need of further financial assistance, and, secondly, there is need of guidance and direction. It is impossible to-day to teach Medicine out of students' fees or uncertain endowment as it ought to be taught. The result is that medical education and research are starved. As in Europe, so in England, there must be more substantial aid from the State if the undertaking is to be placed upon a satisfactory national basis.* For only thus can the predominant authority of the University be secured as against the claim of proprietary interest; only thus can be met the necessary expenditure for equipment and for adequate remuneration of the staff which is entailed in obtaining efficiency.

If financial assistance be the first requirement it is intimately associated with the further and collateral necessity for direction as to its wise, economical and purposive outlay. We need throughout the medical curriculum—in preliminary science, intermediate and clinical subjects—an education of university standard, not subservient to an examination system, but directed and inspired by competent leaders in each Medical Faculty, leaders of educational purpose, attainment and experience, of fertile intellect and forward-looking mind, devoted to their high calling as teachers and investigators. I recognise that the disbursement of public money in the form of subvention for these special purposes places a responsibility upon the Board of Education for supervision and advice, functions to be exercised with due regard to the freedom of the University or Medical School authorities concerned and in sympathetic co-operation with their Medical Faculties.

The Results of the Board's Grants.

161. The Board of Education has made a beginning in this direction (*see* Section I.) by means of its grants in aid, now amounting to upwards of 40,000*l.* a year.† The general grounds and conditions governing the

* *Medical Education in Europe*, 1912: The Financial Aspects of Medical Education, pp. 287–307.

† This sum refers only to grants under the Statement: it does not include the Treasury grants to Universities and University Colleges, from which, of course, some Medical Schools also derive indirect assistance.

allocation of these grants have been already mentioned. The specific medical points which are taken account of in the assessment include the following:—

(*a*) The number of whole-time and part-time students in attendance.
(*b*) The general standard, control and governance of the Medical School (*see* Section I.).
(*c*) The content and scope of each subject taught.
(*d*) The educational staff, number, status, qualification, remuneration, duties, and grade of student taught.
(*e*) The equipment of each Department, classrooms, laboratories, materials, apparatus, library, museum, &c. Accommodation and facilities for hospital instruction.
(*f*) The mode of conducting the course; the University standard and character of teaching; personal, tutorial, demonstrations, lectures; practical and clinical work; bedside tuition and clinical demonstrations; individual study; college examinations.
(*g*) The inter-relation of the subject with the remainder of the curriculum, and of laboratory with clinical work.
(*h*) Facilities for and nature of research work.

The relativity of these eight items naturally differ in different Schools and Universities, and in special Schools or courses other particular matters arise. It would be well if the governing bodies of each of the 22 Medical Schools in England periodically reviewed their provision for medical education under these headings, for in some cases at least they are imperfectly informed as to the needs of Medicine in the University under their charge.

162. Finally, whilst it is inappropriate to state in detail the use to which the Board's grants have been devoted by the respective authorities, a number of typical examples may be quoted (furnished by the respective Deans) to indicate something of what is happening as a result of this State subvention:—

I.

A London Medical School.

The Grant from the Board of Education has allowed the College to effect the following changes:—

1. **To increase in certain cases and to guarantee the salaries of all whole-time teachers by making the salaries independent of Capitation fees.**
2. **To provide whole-time assistants in certain departments and to increase the salaries of all assistants.**

   By these two measures we were enabled to conform to the regulations of the University regarding Professorships and Readerships, and to have three Professorships and one Readership attached to the College.
3. **To open two new Departments, viz., Pharmacological and Cardiological.**
4. **To pay for *Routine* Clinical Teaching.**
5. **To pay for *Special* Clinical Demonstrations.**
6. **To join the Federated System of Superannuation for Universities.**
7. **To improve the equipment for teaching, as, for example, by enabling us to purchase two epidiascopes, one for the College, the other for the Hospital, and to equip a Pharmacological Laboratory.**
8. **To ease generally the financial strain on the College.**

II.

A second London Medical School.

But for the grant from the Board of Education the efficiency of the School's work would inevitably have suffered greatly [owing to economies and loss on account of the war].

In addition to the advantage of enabling the School to maintain its general efficiency unimpaired, the grant has enabled the School to have determined upon certain improvements. The lectureship in Physiology has been converted into a University professorship by arrangement with the University of London, and the emoluments raised to the required standard. The emoluments of lectureships in Anatomy, Chemistry and Biology have also been similarly raised. It has been decided to raise the stipend of the lectureship in Pharmacology.

It has been decided also to institute systematic clinical demonstrations, and to re-organize the personnel of the various clinical units by appointing chief, or clinical assistants, in the medical and surgical clinics.

The grant will enable the School to pay adequate salaries to the demonstrators when they return from military duty and normal conditions are resumed.

III.

A third London Medical School.

1. The first purpose to which the grant was put was to improve the salaries of lecturers on the intermediate subjects, but to enable them to carry on the work it was essential that the equipment of the physiological laboratory, used also for pharmacology, should be improved. The whole equipment was thoroughly reorganised and completed in the following year, and special attention was then given to the improvement of clinical teaching. It was found that though the members of the staff were giving much valuable time we were not able to command their services in the same way for regular and systematic teaching as we should be able to do if they were paid for each lecture. It was therefore decided that for systematic lectures and for special classes, apart from clinical teaching in the wards, regular fees should be paid, and for these purposes the Board of Education grant was essential.

2. The next improvement was in the Pathological Department. The salary of the Bacteriologist was increased, the laboratories were extended and their equipment improved, and a lecturer and demonstrator of chemical pathology was appointed. Research studentships in pathology were also established.

3. A further improvement has been the installation of the electro-cardiograph, which has been placed under the charge of one of the physicians.

4. Now that the importance of medical education and the keeping up of the supply of qualified men is recognised by the authorities as an important part of the medical school work, it is a matter of congratulation that, owing to the Board of Education grants, the Medical School of this Hospital has been able to maintain its efficiency.

5. To sum up, therefore, the Board of Education's medical grants have been expended in the following way:—

(*a*) Improved equipment in the Departments of Physiology, Pharmacology, Pathology, and the electro-cardiograph room.

(*b*) Increase of salaries or remuneration for teaching in systematic clinical classes, for the lectureships in Anatomy and Physiology, and for lectures in Pathology and systematic demonstrations in the Medical School. Further, a lecturer on Pharmacology was appointed, and provision made for the teaching of modern methods of treatment of tuberculosis and venereal disease.

IV.

A fourth London Medical School.

The grant from the Board of Education has been expended partly in the upkeep of the Medical School, additional equipment for teaching purposes, and also in—

(i) the appointment of a whole-time Professor of Pathological studies;

(ii) the maintenance of the new departments of Physiology and Pharmacology;

(iii) two additional assistants appointed to the staff of the department of Physiology, one to the department of Anatomy and one to the department of Pharmacology;

(iv) the opening of a Cardiographic Department and the purchase of apparatus for its equipment;

(v) the appointment of a fully-trained Librarian who is in charge of the general and research libraries.

The College authorities have also revised the scheme of remuneration of all members of the academic staff. The new scheme abolished altogether the system of payment by share of fees and replaced it by fixed salaries to the great advantage of all members of the academic staff. In the abnormal period since 1914 when war began, the grant has been of the greatest advantage in enabling the College to continue its work under very difficult circumstances.

V.

A University Medical School outside London.

The Committee desire to place on record their sense of the very great value of the assistance rendered to Medical Teaching in the University by the institution of the Grant. Under the very difficult conditions which have prevailed during the past two years it would have been almost impossible, without its aid, to maintain the various Departments of the Medical School in a state of efficiency, and, to take but one instance, the adequate equipment of the newly established Department of Bio-Chemistry from funds otherwise at the disposal of the University would have been out of the question. With the support afforded by the Grant it may be confidently hoped that the various Departments will find themselves in a position to resume and increase the scope of their former active work when normal conditions are restored.

In the Anatomical Department further specimens and appliances have been provided out of the Grant. Through its valuable assistance also much of the activity of the Bio-Chemistry Department has been rendered possible. Improvements have been made in apparatus and in the library, and the salary of a special assistant has been provided. Without this financial aid the efficiency of this department would have been greatly lessened. The foundation of a University Lectureship in Medical Chemistry (also endowed from the Board of Education Grant) has been a great gain. In the Physiological Department the grant has made it possible to purchase a large centrifuge, and other much needed apparatus including a large number of valuable instruments. It has also enabled a number of early physiological works to be added to the Library: works which must be purchased as opportunity offers. Psychology and Pharmacology were equally benefited, the University being enabled to appoint whole-time teachers of these subjects. The grant was also expended in the purchase of further needful apparatus and a number of new books. Further, with the aid of the grant, the clinical teachers were incorporated as University lecturers with definite duties to the University, which is now able to insist upon more systematic and uninterrupted teaching than could be called for under the old conditions. Teachers in other Departments also can now be more adequately remunerated for their work. . . . It has meant much to us that the Board of Education has taken a broad and liberal view of its functions and of the area over which the grant might be distributed.

VI.

A second University Medical School outside London.

The Board of Education medical grant has been expended under the supervision of the Medical Faculty, as follows:—

(*a*) The appointment of a whole-time Professor of Physiology.

(*b*) The appointment of a whole-time Professor of Pathology.

(*c*) The appointment of new Assistant Professors.

(*d*) The raising of the emoluments of existing Assistants.

(*e*) Improved equipment.

(*f*) The payment of fees for clinical teaching in the hospital under the control of the Clinical Board."

VII.

A third University Medical School outside London.

The medical grants have enabled us to carry out the following developments:—

(1) To take over the control of the clinical teaching of the Medical School. The grants have enabled the University to pay the clinical teachers better than formerly, and thereby to direct the whole of the clinical work. The result has been eminently satisfactory.
(2) To take over on similar lines the clinical teaching of Dentistry.
(3) To institute a lectureship in infant hygiene and diseases peculiar to children.
(4) To institute a lectureship in Orthodontics.
(5) To institute a course of lectures on radiography and radio-therapeutics.

VIII.

A fourth University Medical School outside London.

The Board of Education grants have been used for the following purposes:—

(1) The establishment of a Chair of Anatomy.
(2) The appointment of a lecturer on Chemical Physiology.
(3) The appointment of two clinical tutors—one in Medicine, one in Surgery—at the Hospital.
(4) The standardisation of clinical teaching.
(5) The purchase of an epidiascope and an electro-cardiograph.
(6) The extension of the Physiological and Pathological Departments is anticipated at an early date.

163. From these Returns the character of the use to which the Board's grants have been allocated by the authorities becomes evident. There is in all cases improved equipment and enhanced remuneration, both essential for fruitful instruction; there is in many cases creation of new professorships. But there is something more than this, for in most of the recipient bodies a new scheme of teaching is being introduced, manifesting itself in new or re-organized departments and in the provision of teaching of University standard in intermediate and clinical subjects. This movement of reform is only beginning, but it seems to me to be full of promise for the future. It possesses a two-fold advantage: first, it strengthens and extends the usefulness of the Universities, bringing to their Medical Schools the opportunity of renaissance, both within their own republic of learning and of science and under the authority of their own governance; and, secondly, it contributes to the truer and better education of the medical man, whose training and furnishment is worthy of the State's assistance, for he is the servant of the commonwealth and of all in need of the healing art, and his influence reaches the very fountains of human life.

G. N.

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BOARD OF EDUCATION.

SOME NOTES

ON

MEDICAL EDUCATION IN ENGLAND.

A Memorandum addressed to the President of the Board

BY

SIR GEORGE NEWMAN, K.C.B., M.D., F.R.C.P.,

Chief Medical Officer and a Principal Assistant Secretary of the Board of Education and Medical Assessor to the Universities Branch of the Board.

Presented to both Houses of Parliament by Command of His Majesty.

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